DRAFT

ENVIRONMENTAL ASSESSMENT OF THE
RELOCATION OF A WEATHER TRAINING FACILITY TO
KEESLER AIR FORCE BASE,
BILOXI, MISSISSIPPI

Water and Air Research, Inc.
CONSULTING ENVIRONMENTAL ENGINEERS AND SCIENTISTS

Setting the Standard

DRAFT

ENVIRONMENTAL ASSESSMENT OF THE RELOCATION OF A WEATHER TRAINING FACILITY TO KEESLER AIR FORCE BASE, BILOXI, MISSISSIPPI

Prepared for:

THE DEPARTMENT OF THE NAVY
Southern Division
Naval Facilities Engineering Command

September 15, 1989

Air Force
Environmental Planning Division
(HQ USAF/CEVP)

Room 5B269
1260 Air Force Pentagon
Washington, DC 20330-1260

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COVER SHEET

Lead Agency and Responsible Contributors:

The lead agency for this assessment is the U.S. Air Force, with the major responsible contributor being Southern Division, Naval Facilities Engineering Command, located in Charleston, South Carolina.

Title of the Proposed Action:

This report presents an Environmental Assessment of the Relocation of a Weather Training Division to Keesler Air Force Base (AFB), Biloxi, Mississippi, as required by the National Environmental Policy Act (NEPA) in accordance with Public Law 100-526 and OPNAVINST 5090.1.

Contact Person at Responsible Command:

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Document Designation:

Environmental Assessment (EA).

Abstract:

This report contains an analysis of the potential environmental impacts of the relocation of the Weather Training Division and associated personnel from Chanute AFB (Rantoul, Illinois) to Keesler AFB (Biloxi, Mississippi) as part of the Secretary of Defense's decision regarding base realignments and closures.

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SUMMARY SHEET

Statement Status:

Environmental Assessment.

Name and Type of Action:

The action detailed in this assessment is the relocation of a Weather Training Division and associated personnel from Chanute AFB (Rantoul, Illinois) to Keesler AFB (Biloxi, Mississippi) as part of the Secretary of Defense's decision regarding base realignments and closures. This is an administrative action.

Description of Proposed Action:

The Secretary of Defense's Commission on Base Realignments and Closures released its report in January 1989. The Commission's recommendations identified Chanute AFB for closure. Keesler AFB was selected for the relocation of the Weather Training Division and associated personnel located at Chanute AFB. The following projects at Keesler AFB are connected with this relocation:

1. Construction of a new 83,700-square-foot weather training facility and associated antenna field.
2. Relocation of approximately 1,258 military and civilian personnel and their dependents.
3. Renovation of Dorm 7101 and the Dining Hall in 7401.
4. Future construction and installation of the Next Generation Weather Radar (NEXRAD) system to be located approximately 9 miles northwest of Keesler AFB.

Environmental Impact:

No significant environmental impact is expected as a result of the proposed action. Alternatives for the relocation of the Weather Training Division are not addressed since (as stated in Public Law 100-526) the decision to close particular bases and move their assets to other bases has already been made.

Statement of Environmental Impact:

It is concluded that the proposed action will have no significant adverse effects on the environment. There has not been, nor is there currently, any known controversy concerning the proposed action. Based upon this Environmental Assessment, it is concluded that no additional environmental documentation is required.

1.0 INTRODUCTION

1.0 INTRODUCTION

Thi· environmental assessment (EA) evaluates the relocation of a Weather T .ining Division and associated personnel from Chanute AFB (Rantoul, Illinois) to Keesler AFB (Biloxi, Mississippi) as part of the base realignment and closure policy.

In the interest of operational efficiency and mission consolidation, the Secretary of Defense created a bipartisan commission to identify facilities, property, and installations which were no longer essential to current or programmed requirements. The charter signed by the Secretary on May 3, 1988 established the Commission on Base Realignment and Closure (Commission) with 12 members appointed by the Secretary of Defense. Public Law 100-526, Section 201, states that the Secretary shall:

1. Close all military installations recommended for closure by the Commission.
2. Realign all military installations recommended for realignment by the Commission.
3. Initiate all such closures and realignments no later than September 30, 1991, and complete all such closures and realignments no later than September 30, 1995, except that no such closure or realignment may be initiated before January 1, 1990.

As defined and used in Public Law 100-526, the term "realignment" "includes any action which both reduces and relocates functions and civilian personnel positions." In mid-1988, the Air Force began providing information on all Air Force installations to the Commission and the Commission released its report by January 1989. The Commission's recommendations identified Chanute AFB for closure and Keesler AFB as a candidate for consolidation of training.

Chanute AFB is located in Rantoul (Champaign County), Illinois, approximately 12 miles north of Champaign-Urbana and 120 miles south of Chicago. Established in 1917 as a World War I flying-training base,

Chanute AFB is the Air Force's oldest technical training center and third oldest air base. The airfield was closed in 1971 and the apron and runways are now used for vehicular access and parking. Chanute AFB has four technical training groups. The 3340th Technical Training Group offers training in the fields of automotive mechanics, fire protection, life support, and metals technology. The 3350th offers turboprop and jet engine maintenance, maintenance management, as well as weather observation, forecasting, and weather equipment repair. The 3360th offers courses in missile maintenance, electronics principles, flight training devices, and instrument flight control training. The 3370th offers aircraft systems, fuels, and aerospace ground equipment/egress training. In addition, the 3345th Air Base Group is responsible for the services and maintenance of the physical facilities of the base. Additional activities on base include: USAF Hospital-Chanute; 3314 Management Engineering Squadron, Detachment 1; 505 Air Force Band; 1963rd Communications Squadron; 3505th Recruiting Group; and other small Department of Defense (DOD) units (Department of the Air Force 1987). Chanute AFB serves approximately 2,580 active military and 2,680 civilian employees. It has an average daily student load of approximately 3,200 with a total active base population of approximately 9,500. Approximately 21,000 students are trained each year in the technical fields.

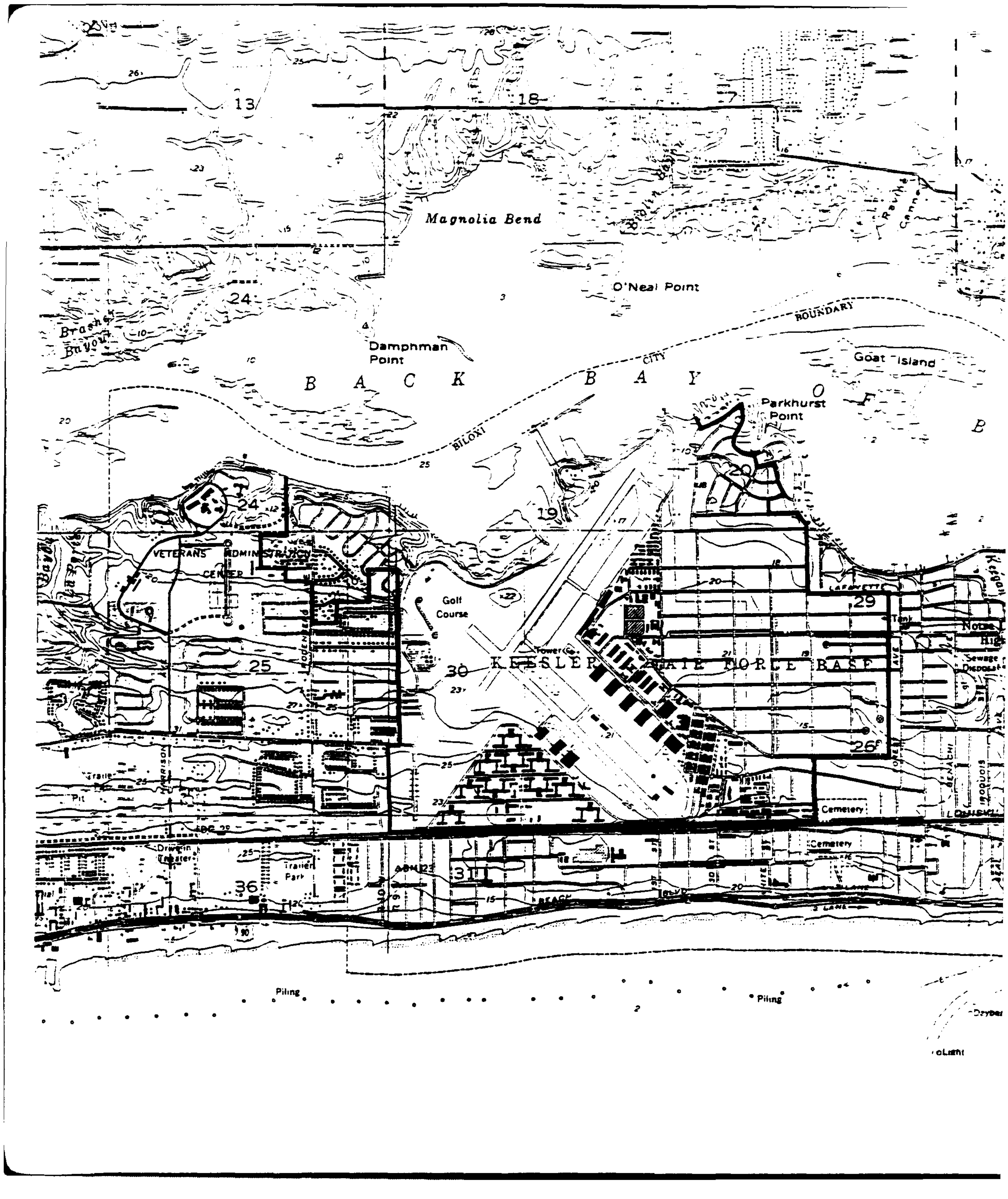
The Weather Training Division at Chanute AFB develops, maintains, and conducts resident, mobile training team, and career development course training in weather observation, forecasting, and advanced meteorology for all DOD agencies. The Weather Training Facility at Chanute AFB is a new academic facility (opened for use in August 1989) constructed of structural steel and masonry with concrete floors and an enclosed observation mezzanine at the roof level. The 2-story building provides classrooms, equipment laboratories, training areas, administrative offices, an observation mezzanine, and necessary support functions and utilities with 93,000 square feet of space. Typical classrooms have vinyl composition tile floors, painted gypsum-board walls, and acoustical ceiling panels (USACOE 1987).

The Air Force, under direction from the Commission, proposes to close Chanute AFB beginning in 1990. The Weather Training Division and associated personnel will be relocated to Keesler AFB thereby expanding the mission of Keesler AFB. Current plans are to have the last classes taught at Chanute AFB to begin during May 1992 and the first classes taught at Keesler AFB to begin in July 1992. Relocation of the Weather Training Division will require the following actions at Keesler AFB:

1. Construction of a new 83,700-square-foot weather training facility and associated antenna field.
2. Relocation of approximately 1,258 military and civilian personnel and their dependents.
3. Renovation of Dorm 7101 and the Dining Hall in 7401.
4. Future construction and installation of the Next Generation Weather Radar (NEXRAD) system which will be located approximately 9 miles northwest of Keesler AFB on military property in the De Soto National Forest.

Located on land donated by the City of Biloxi in 1941, Keesler AFB has been a dominant presence on the Gulf Coast (Figure 1-1). The main base comprises 1,494 acres of land under federal jurisdiction, and another 117 acres of contiguous land which is leased, in permitted use, or in easements. Training Annex No. 1 consists of 57 acres of federal land about 2 miles west of the main base and includes housing and recreational facilities. The Small Arms Range Annex is a 1,877-acre reserve in north-central Harrison County which includes 10 acres of federal land, with the remainder under permits for federal use.

Keesler AFB is known as the largest electronics and computer training center of the Air Training Command. The military personnel are trained in administration, communications, electronics, avionics, and air traffic control. Keesler AFB is currently the home of the Keesler Technical Training Center, the 3300 Technical Training Wing, 3380 Air Base Group, USAF Hospital-Keesler, and other smaller DOD units. Keesler AFB


13
18
Magnolia Bend
O'Neal Point
24
Brashek Bayou
Damphman Point
Goat Island
B A C K B A Y O F B
CITY BOUNDARY
BILOXI
Parkhurst Point
19
24
VETERANS ADMINISTRATION CENTER
Golf Course
29
Tank
KEESLER AIR FORCE BASE
Tower
25
30
26
Sewage Disposal
HARRISON
Trailer
Pit
Cemetery
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Drive-in Theater
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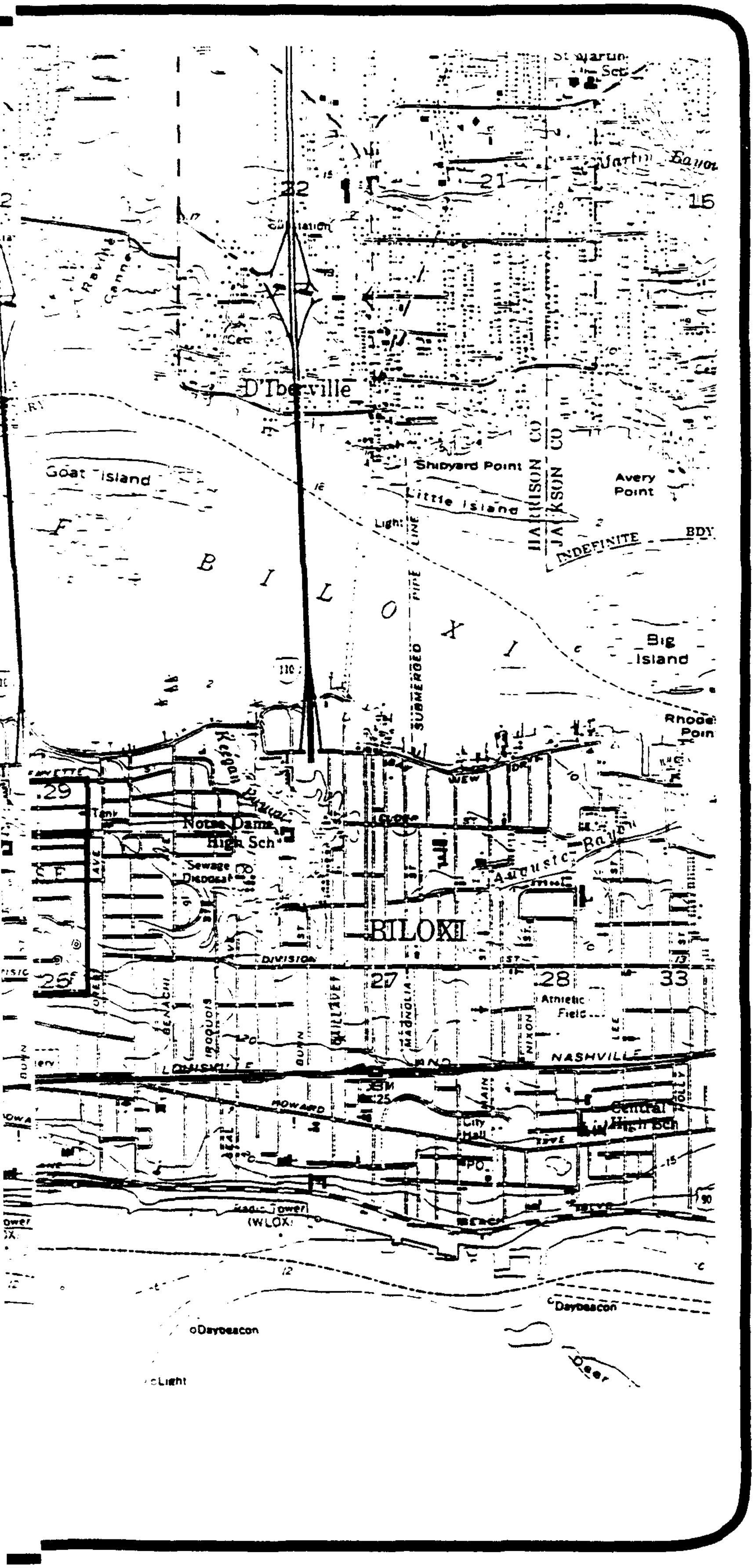
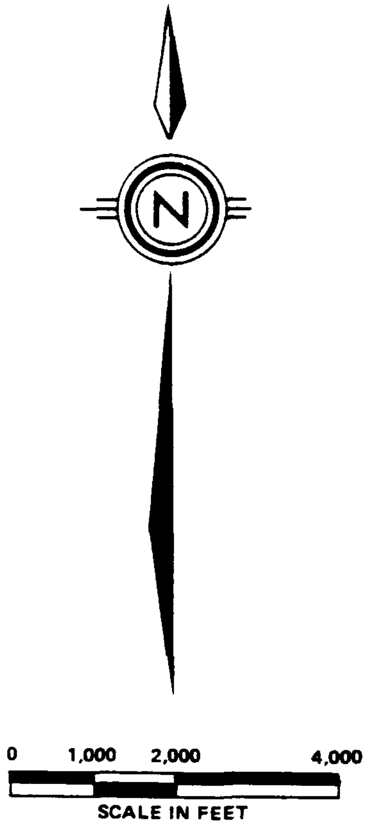




ENVIRONMENTAL ASSESSMENT OF THE RELOCATION OF A WEATHER TRAINING FACILITY TO KEESLER AIR FORCE BASE, BILOXI, MISSISSIPPI

FIGURE 1–1. Location of Keesler AFB, Biloxi, Mississippi

SOURCE: USGS 1954.
WAR 1989.

consists of approximately 4,600 active military personnel and 750 reservists. There are approximately 4,500 civilian employees. It has an average daily student load of approximately 3,800 and a total active base population of approximately 9,900.

This assessment will examine the current environmental and socioeconomic conditions in the vicinity of Keesler AFB. In addition, the potential consequences of the proposed action to relocate the Weather Training Division to Keesler AFB will be investigated. Specific factors considered will relate to the impact of the construction of the new facilities and renovation of current facilities (locations shown in Figure 1-2), and the socioeconomic and environmental impacts of the increase in personnel at Keesler AFB and in the surrounding community.

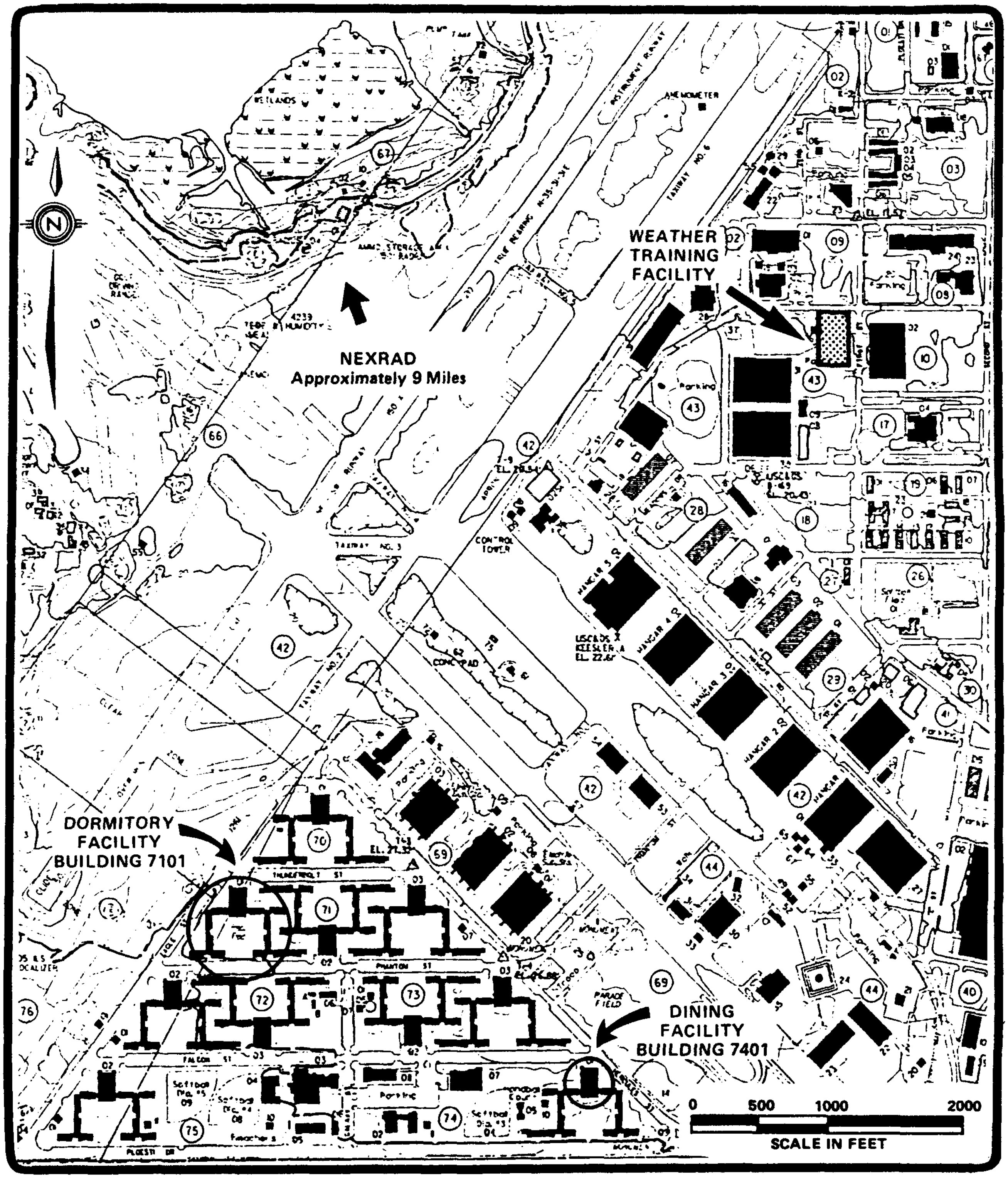


FIGURE 1–2. Project Sites Associated with the Relocation of the Weather Training Division to Keesler AFB

SOURCE: Mid States Engineering Inc. 1987. WAR 1989.

ENVIRONMENTAL ASSESSMENT OF THE RELOCATION OF A WEATHER TRAINING FACILITY TO KEESLER AIR FORCE BASE, BILOXI, MISSISSIPPI

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

Chanute AFB was selected for closure by the Secretary of Defense's Commission on Base Realignments and Closures (referred to herein as "Commission"). Keesler AFB was selected for the relocation of the Weather Training Division and associated personnel located at Chanute AFB. This action was decided in the interest of operational efficiency and mission consolidation.

2.1 ALTERNATIVES CONSIDERED

Public Law 100-526 waives NEPA compliance for the actions of the Commission and for the Secretary's decision to accept the Commission's recommendations. Therefore, the decision to close Chanute AFB and move its assets to other bases has already been made and does not require further documentation. Public Law 100-526 states, in addition, that identification of alternative military installations to those selected by the Commission is not required. For this reason, alternatives to the proposed action will not be discussed.

2.2 PROPOSED ACTION

The action addressed in this environmental assessment is the relocation of the Weather Training Division and associated personnel from Chanute AFB (Rantoul, Illinois) to Keesler AFB (Biloxi, Mississippi) as part of the Secretary of Defense's decision regarding base realignments and closures. This is an administrative action in the interest of operational efficiency and mission consolidation of military installations.

The mission of Keesler AFB will be expanded to include training in weather observation, forecasting, and advanced meteorology for military personnel. Relocation of the Weather Training Division from Chanute AFB to Keesler AFB will include the construction of a new Weather Training Facility and the Permanent Change of Station for approximately 782

military and civilian personnel and their dependents. In addition, the average student population is expected to be 476 at any given time. Specific projects (see Figure 1-2 for locations) associated with the relocation of the Weather Training Division include:

1. Construction of a new 83,700-square-foot Weather Training Facility and associated antenna field. As currently proposed (USAF 1989a), the new facility will be a 2-story structural steel and masonry building with concrete footings and floors, masonry walls, storm-resisting roof systems, and an observation deck. The facility will include administrative, academic, and laboratory areas to provide instruction and laboratory training in all aspects of weather theory, instrumentation, and equipment maintenance. The facility will be designed in an architectural style compatible with existing buildings constructed on Keesler AFB since 1972.
2. Renovation of Dorm 7101 and the Dining Hall in 7401 to provide housing and dining areas for a portion of the personnel assigned to the Weather Training Facility. The work to be completed (USAF 1989b) includes replacing deteriorated mirrors, shelving, light fixtures, bedroom wardrobes, doors and frames, smoke detectors, floor coverings, and stair treads. Existing open ceilings will be covered with gypsum board, and concrete floors which have settled will be repaired.
3. Relocation of approximately 1,258 military and civilian personnel and their dependents to the Keesler area.
4. Future construction and installation of the Next Generation Weather Radar (NEXRAD) system to be located approximately 9 miles Northwest of Keesler AFB on military property in the De Soto National Forest. The proposed site (latitude 30° 31' 25" north and longitude 88° 59' 05" west) is near the U.S. Air Force firing range and located between the firing range and Highway 67 in a natural stand of pine trees. An area approximately 100 feet by 100 feet will be cleared and fenced. Within

this area, a concrete pad will be located upon which the NEXRAD radar dome will be placed. The pad will be approximately 25 feet by 25 feet. The radar system will transmit a pencil beam at a frequency of 2,870 megahertz or, when necessary, an alternative frequency of 2,880 megahertz (Morton 1989). NEXRAD will utilize at least three pulse-repetition frequencies between 500 and 1,200 pulses per second (NEXRAD PEIS 1984).

This environmental assessment is being prepared to determine what environmental and socioeconomic impacts the proposed action will have on Keesler AFB and the Biloxi area.

3.0 EXISTING ENVIRONMENT OF THE PROPOSED ACTION

3.0 EXISTING ENVIRONMENT OF THE PROPOSED ACTION

The proposed action is the relocation of the Weather Training Division and associated personnel from Chanute AFB (Rantoul, Illinois) to Keesler AFB (Biloxi, Mississippi). Keesler AFB is located along the Gulf of Mexico in Mississippi. The existing environment in the vicinity of the construction/renovation sites will be described in order to permit determinations of what effects the proposed action will have on the area.

3.1 PHYSICAL SYSTEMS

Physical systems can be divided into the following segments: geology and physiography, regional weather patterns, surface water, groundwater, air quality, and noise. Detailed descriptions of each of these components for the Biloxi area are presented in the following sections.

3.1.1 GEOLOGY AND PHYSIOGRAPHY

Keesler AFB is located within the city limits of Biloxi, Mississippi, approximately halfway between New Orleans, Louisiana and Mobile, Alabama, at a latitude of 30° 24' north and a longitude of 88° 55' west. The base is bordered (see Figure 1-1) on the east, west, and south by residential and commercial areas and on the north by the Back Bay of Biloxi. The base is approximately 0.5 mile north of Mississippi Sound.

Keesler AFB and the surrounding area are located within the Coastal Lowlands Subdivision of the Eastern Gulf Coastal Plain (USACOE 1984b). Topography is generally rolling to flat, but in the northernmost part of the Coastal Plain, elevations can reach 700 feet above sea level (SOUTHDIVNAVFACENGCOM 1986a). The Coastal Lowlands are flat and locally swampy, with a shoreline consisting of drowned river valleys. Tidewater creeks and rivers characterize the coastline, and tidal marshes can reach a width of up to 10 miles.

3.1.1.1 Topography and Bathymetry

Keesler AFB is located on a peninsula dividing Back Bay of Biloxi and Mississippi Sound. This peninsula is 1.5 miles wide and extends eastward for approximately 8 miles. Keesler AFB borders on Back Bay of Biloxi which is located to the north of the air base. This boundary is characterized by salt marshes and tidal mud flats with elevations of less than 5 feet above mean sea level (msl). There is little relief on the base (see Figure 3.1.1.1-1). The maximum elevation is slightly more than 30 feet msl at the golf course, east of the airfield. The majority of the base has an elevation of approximately 20 feet msl. These elevations are characteristic of the Biloxi peninsula. The elevation of the proposed site for the new Weather Training Facility is approximately 20 feet msl with very little relief (USGS 1954). The elevation at the proposed NEXRAD installation site is approximately 100 feet msl.

The bathymetry of Mississippi Sound in the vicinity of Keesler AFB (see Figure 3.1.1.1-2) shows similarly low relief. The depth distribution of Mississippi Sound at mean low water (mlw) shows that 99 percent of the total basin area is 20 feet (6.10 meters) deep or less. The Sound is relatively shallow (2.97 meters or 9.74 feet deep) at mlw. It is considered a bar-built estuary or coastal lagoon which exhibits estuarine characteristics (Eleuterius and Beaugez 1979; SOUTHDIVNAVFACENGCOM 1986b). The Sound is bordered by Mississippi and Alabama on the north, Mobile Bay on the east, Lake Borgne on the west, and the Gulf of Mexico on the south. A chain of barrier islands, including Ship, Horn, Cat, Petit Bois, and Dauphin Islands, partially separates the Sound from the Gulf of Mexico. These islands are either vegetated beach ridges with an elevation between 5 and 15 feet msl, or broad, low (1 to 2 feet msl) sand flats with marshes and shallow lakes. Some of these lakes are intermittently connected to Mississippi Sound or the Gulf of Mexico (SOUTHDIVNAVFACENGCOM 1986a). The islands are surrounded by shallow (3 to 6 feet deep) shoal areas, which are covered by sand/wave-type underwater bars that extend close to island shores. Ship Island was breached

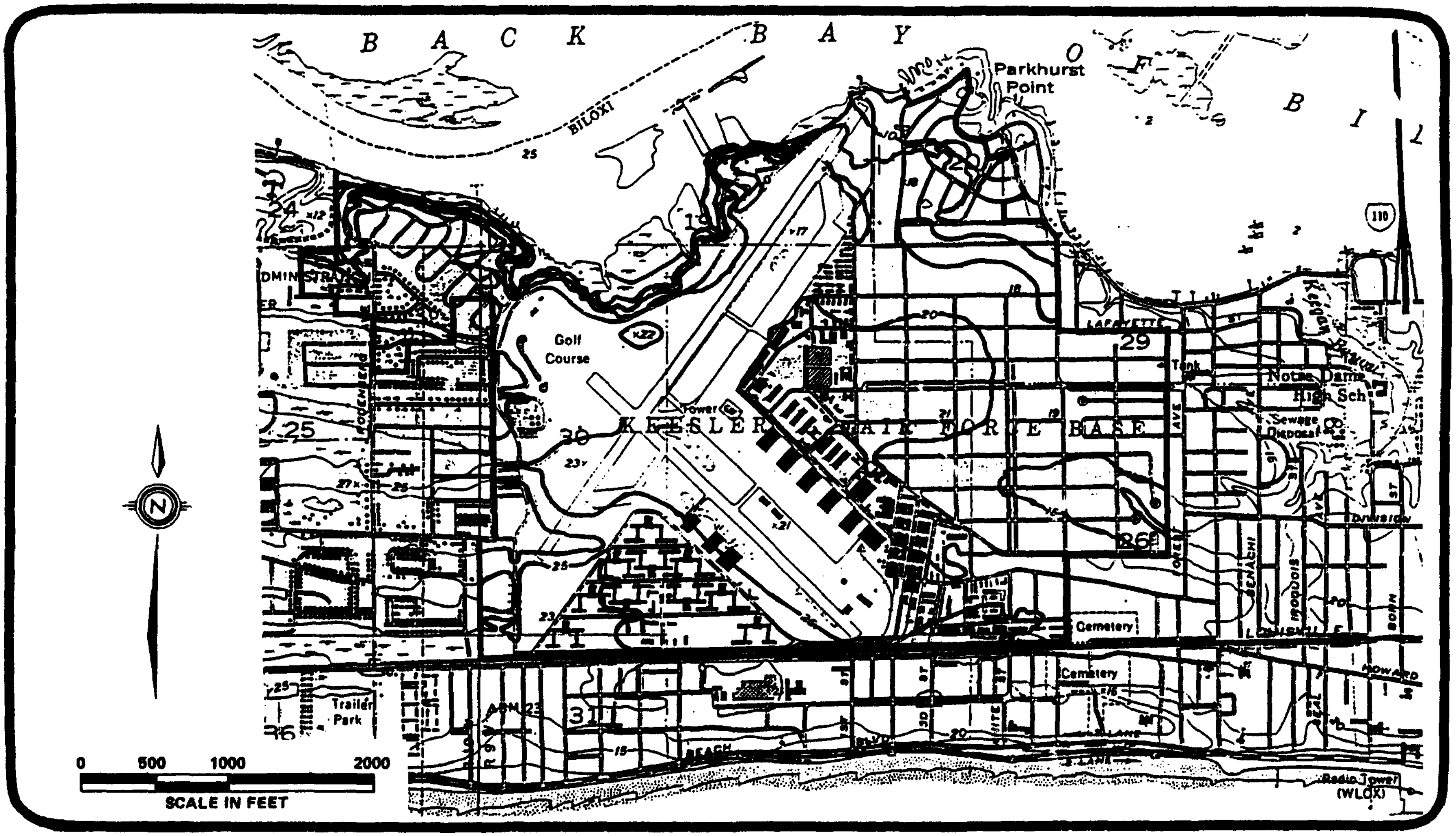
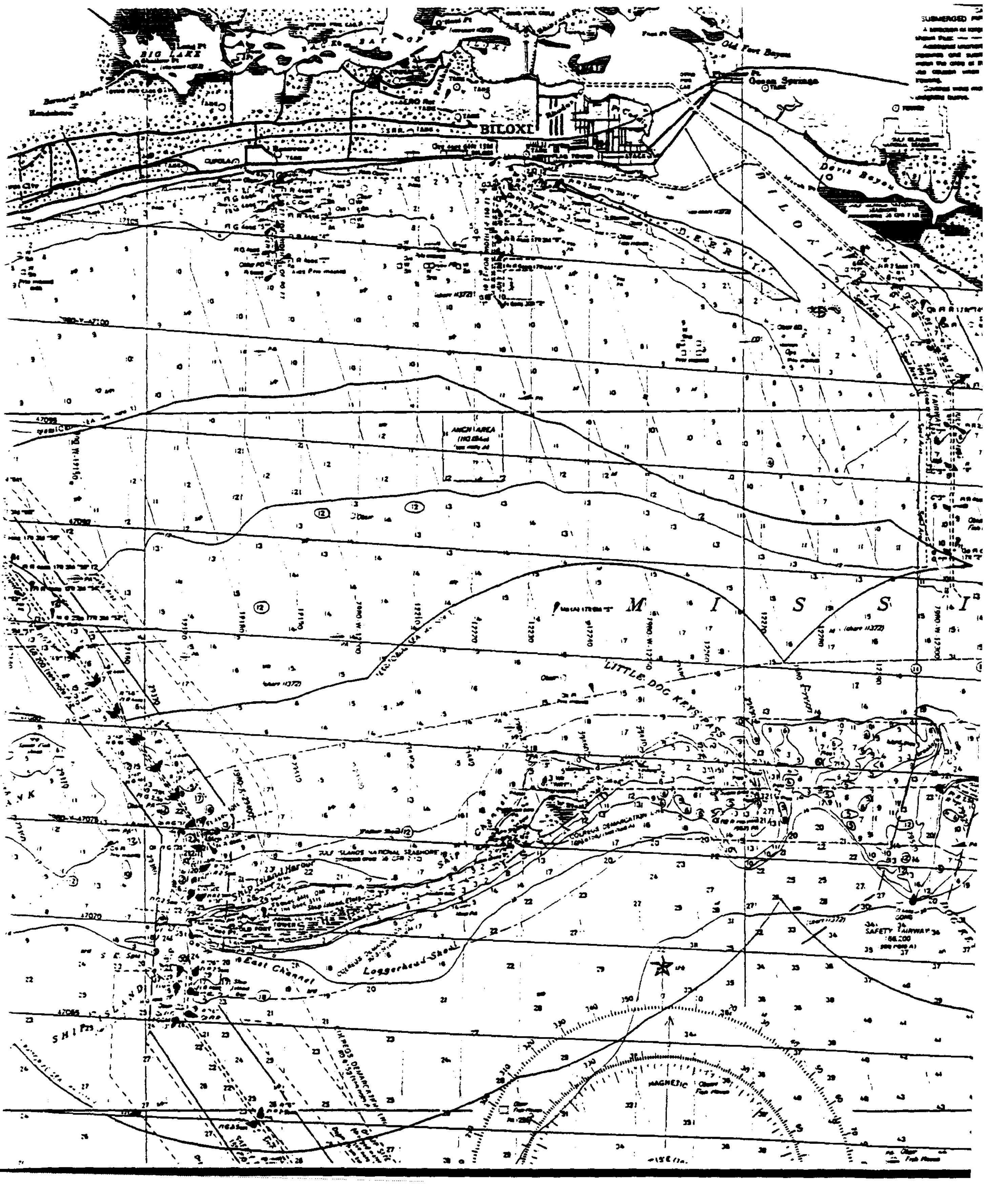
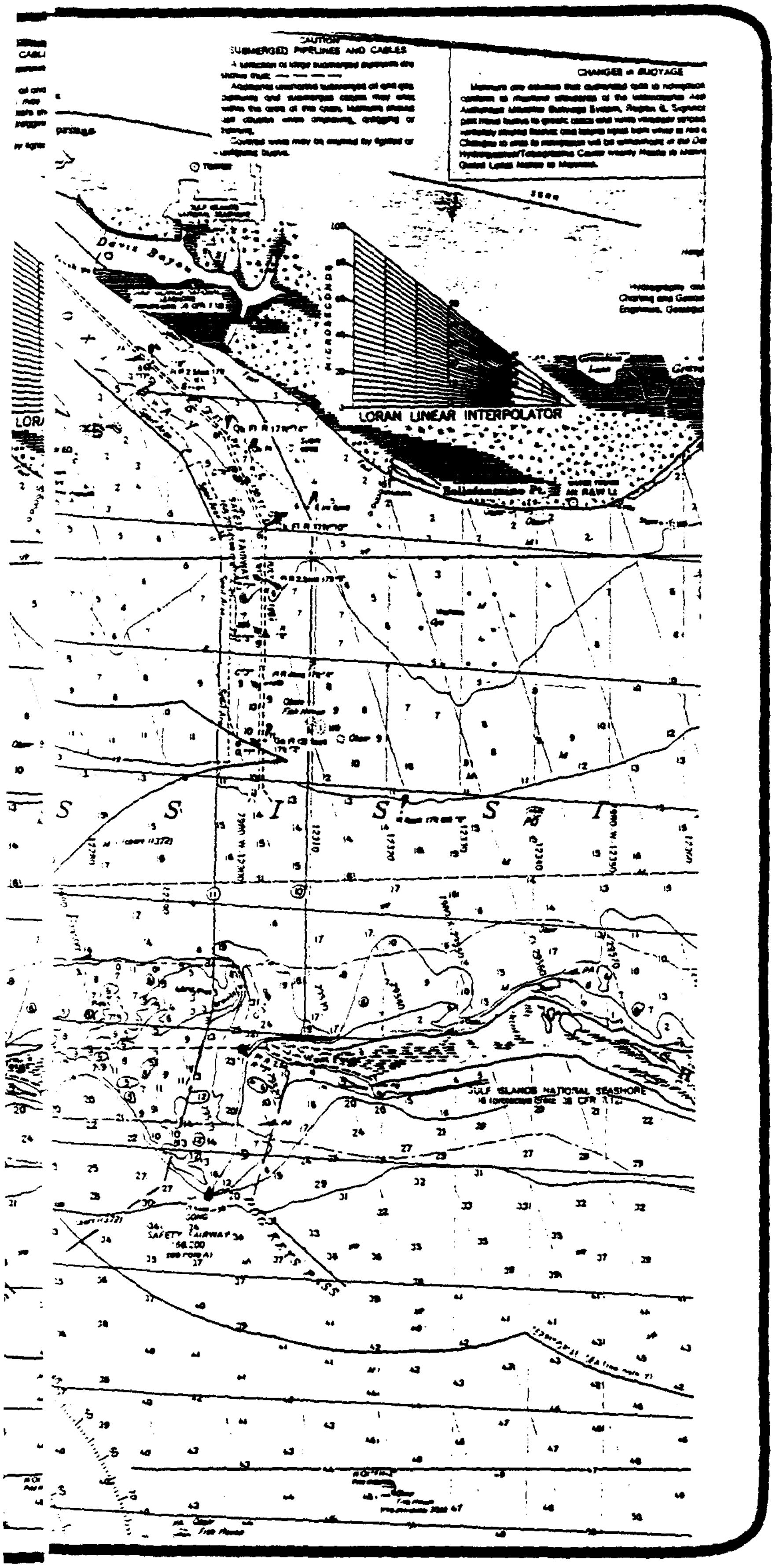


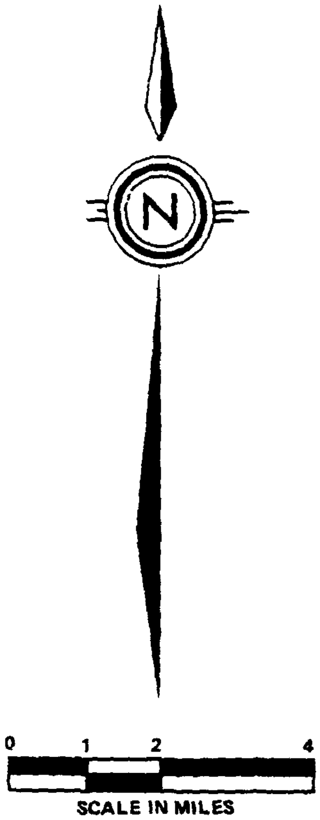
FIGURE 3.1.1.1–1. Topography and Bathymetry of Keesler AFB and the Biloxi Area

SOURCE: USGS 1954.
WAR 1989.

ENVIRONMENTAL ASSESSMENT OF THE RELOCATION OF A WEATHER TRAINING FACILITY TO KEESLER AIR FORCE BASE, BILOXI, MISSISSIPPI


BIG LAKE
BILOXI
Ocean Springs
Old Fort Bayou
Davis Bayou
ANCH AREA
M I S S I
LITTLE DOG KEYS PASS
GULF ISLANDS NATIONAL SEASHORE
East Channel
Loggerhead Shoal
SHIP ISLAND
MAGNETIC
SAFETY FAIRWAY
SUBMERGED





ENVIRONMENTAL ASSESSMENT OF THE RELOCATION OF A WEATHER TRAINING FACILITY TO KEESLER AIR FORCE BASE, BILOXI, MISSISSIPPI

FIGURE 3.1.1.1–2. Bathymetry in Mississippi Sound near Keesler AFB

SOURCE: NOAA 1984.
WAR 1989.

(2)

in 1969 by the passage of Hurricane Camille, resulting in 2- to 6-foot water depths between East and West Ship Islands (NPS 1978).

The passes between the islands are relatively shallow, with the exception of Little Dog Keys Pass (midway between Horn and Ship Islands) and the areas at the immediate western tips of the islands. These natural depths are caused by tidal scouring action (Eleuterius and Beaugez 1979).

Three channels across the Sound provide deep-water access to the mainland. Pascagoula Channel has an authorized depth of 40 feet and Gulfport Channel has an authorized depth of 32 feet. Biloxi Channel has an authorized depth of 12 feet (Eleuterius and Beaugez 1979).

Biloxi Channel is only dredged in the areas which are less than 12 feet deep. Disposal of dredge spoil obtained from channel construction or maintenance in Mississippi Sound is customarily accomplished by placing the spoil along the channel, a procedure described as "side casting" (Eleuterius and Beaugez 1979). Material dredged from the Biloxi Bay portion of the channel is placed in upland disposal sites (Nester 1989).

Biloxi Channel originates southwest of Horn Island and passes through Dog Keys Pass, entering the Back Bay of Biloxi. It is primarily used by commercial fishing vessels, tugs, and barges (MDWC 1989).

3.1.1.2 Soils

Data on soils in Harrison County are available in the Soil Survey of Harrison County, Mississippi (Smith 1975). The coastal area of Harrison County is dominated by a group of sandy soils which may have a loamy subsoil. This soil group is known as the Eustis-Lakeland-Latonia Association, and is found in a broad band just north of Mississippi Sound. The association is approximately 2 miles wide in Biloxi and tapers to 0.5 mile at Pass Christian.

Eustis soils are somewhat excessively drained and have a loamy sand surface layer and a loamy sand subsoil. Latonia soils also have loamy sand surface layers and loamy sand subsoils, but are characterized as well-drained. Lakeland soils have a fine sand surface layer and fine sand underlying layers and are well-drained. Other soils such as Poarch, Handsboro, Harleston, and Sulfaquept can be found in areas dominated by the Eustis-Latonia-Lakeland Association.

Keesler AFB is located within the band of Eustis-Lakeland-Latonia soils. Table 3.1.1.2-1 lists the soil types found on Keesler AFB. Most of the base (see Figure 3.1.1.2-1), including the proposed site for the Weather Training Facility, is characterized as Eustis loamy sand (EtB) with a slight (0 to 5 percent) slope. A band of Harleston fine, sandy loam (HlA) extends across the western portion of the base, approximately along the northwest-southeast runway, and a small area showing characteristics of dredged soil (Sulfaquept-Sw) is located on the western border of the base. Bands of Plummer (Pm) soil are found in the far western portion of the base. Eustis, Harleston, Lakeland, Poarch (well-drained soils which formed in loamy materials), and Handsboro (very poorly drained soils adjoining salt or brackish water) soils are found near the water north of the airfield (Smith 1975).

3.1.1.3 Structural Geology

The Gulf Coastal area has been sinking for millions of years, forming a geosyncline, which has been described as a "vast, sinking trough" (Newcome, et al. 1968). This geosyncline is an early Cenozoic structural basin, and streams draining into the Gulf have, for more than 60 million years, kept the trough nearly full of mud, sand, and gravel deposits. As a result, the Mississippi Gulf Coast is underlain by deltaic and estuarine sediments, consisting primarily of clay, silt, and sand, which are referred to in Figure 3.1.1.3-1 as alluvium coastal deposits. Over time, these sediments have accumulated in a narrow band along Mississippi Sound to a depth which probably exceeds 30,000 feet (SOUTHDIVNAVFACENGCOM 1986b; Newcome, et al. 1968).

Table 3.1.1.2-1 Description of Soil Types Found on Keesler AFB
(Page 1 of 2)

Eustis Series
The Eustis series consists of somewhat excessively drained soils that formed in sandy material on uplands. Slopes are 0 to 17 percent.

EuE: Eustis and Poarch soils, 8 to 17 percent slopes. This mapping unit is on rough hilly uplands. The landscape, chiefly forested, is one of narrow ridgetops and sloping to moderately steep side slopes broken by numerous short drainageways. Runoff and erosion are hazards in bare and unprotected areas.

EtB: Eustis loamy sand, 0 to 5 percent slopes. This is a somewhat excessively drained soil on ridgetops. Permeability is moderately rapid, and available water capacity is low. There is little or no runoff. Soil blowing is a hazard where the soil is left bare and unprotected in dry periods.

Handsboro Series
The Handsboro series consists of very poorly drained soils that formed in highly decomposed herbaceous plant remains and thin mineral layers. These soils adjoin salt or brackish water at elevations of less than 2 feet and are periodically flooded by high tides.

Ha: Handsboro Association. This is dominantly a very poorly drained, well-decomposed, organic soil on broad, wet, grassy flats along the coast, adjoining salt water or brackish water at elevations of less than 2 feet. Slopes are 0 to 2 percent.

Harleston Series
The Harleston Series consists of moderately well-drained soils that formed in loamy materials on uplands. Slopes are 0 to 5 percent.

HlA: Harleston fine sandy loam, 0 to 2 percent slopes. This is a moderately well-drained soil on ridgetops. Permeability is moderate, and available water capacity is medium. Runoff is slow.

HlB: Harleston fine sandy loam, 2 to 5 percent slopes. This moderately well-drained soil is on ridgetops, around heads of drainageways,and on side slopes. Permeability is moderate and available water capacity is medium. Runoff is slow to medium. Erosion is a slight hazard where the soil is bare and unprotected.

Table 3.1.1.2-1 Description of Soil Types Found on Keesler AFB
(Page 2 of 2)

Lakeland Series
The Lakeland series consists of excessively drained soils on uplands. These soils formed in sandy material.

Lr: Lakeland fine sand. This is an excessively drained soil on broad low ridges. Slopes are 0 to 5 percent. Permeability is rapid and available water capacity is low. There is little or no runoff.

Plummer Series
The Plummer series consists of poorly drained soils that have a thick sandy surface layer over loamy materials.

Pm: Plummer loamy sand. This is a poorly drained soil on wet flats and in drainageways. Slopes are 0 to 2 percent. Permeability of the surface and subsurface layers is rapid, and permeability of the subsoil is moderate. The available water capacity is low. Runoff is slow or very slow.

Poarch Series
The Poarch series consists of well-drained soils that formed in loamy materials. These soils are on upland. Slopes are 0 to 17 percent.

Sulfaquepts
The Sulfaquepts consist of soils that formed in areas of hydraulic fill. They are along the marshes, beaches, and the Harrison Couny Industrial Waterway.

Sw: These soils were accumulated by diking, then filling the dikes with sand, silt, and mud by pumping and using brackish water or sea water. The materials in these areas, although dominantly sands, are variable in texture, ranging from sand to silty clay and clay. These soils contain sulfur. A few months after an area has been filled, patches of yellow elemental sulfur form on the surface. The available water capacity generally is low. Included in this mapping unit are small areas of fills that are used for building sites and lawns.

Source: Smith 1975.

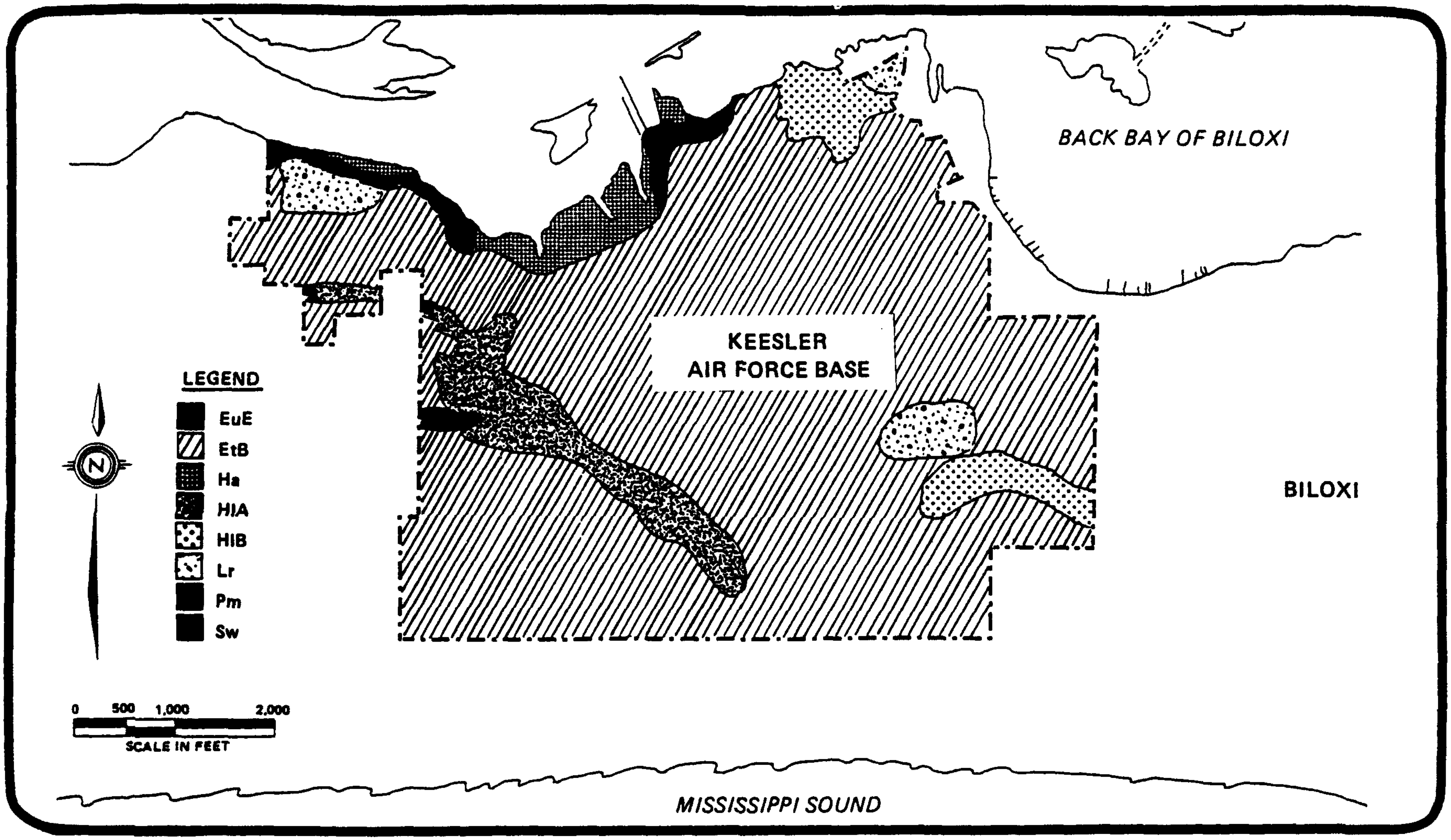


FIGURE 3.1.1.2–1. Soil Types on Keesler AFB

SOURCE: Smith 1975.
WAR 1989.

ENVIRONMENTAL ASSESSMENT OF THE RELOCATION OF A WEATHER TRAINING FACILITY TO KEESLER AIR FORCE BASE, BILOXI, MISSISSIPPI

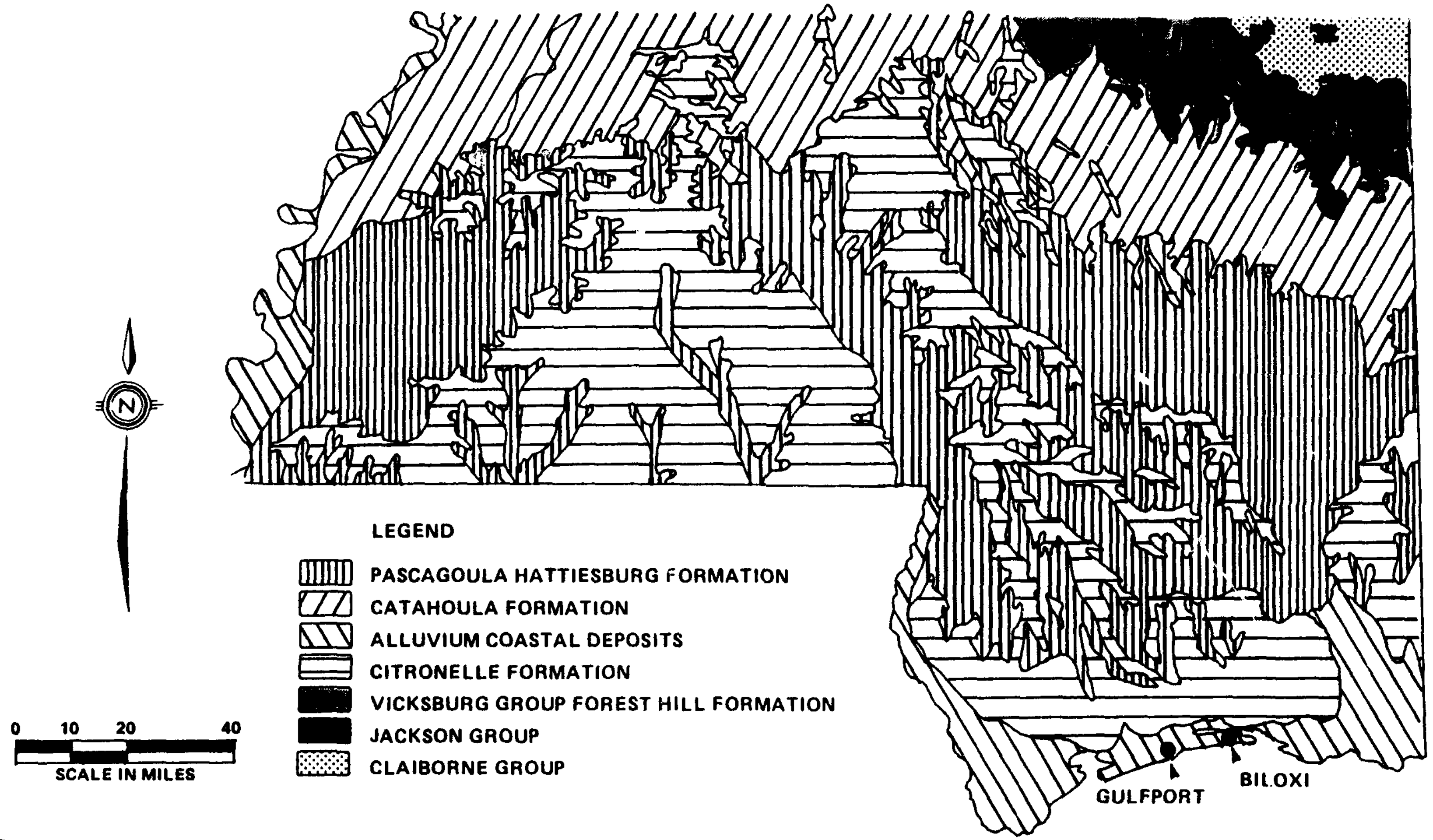


FIGURE 3.1.1.3–1. Geologic Map of Southern Mississippi

SOURCE: USGS 1976.
WAR 1989.

ENVIRONMENTAL ASSESSMENT OF THE RELOCATION OF A WEATHER TRAINING FACILITY TO KEESLER AIR FORCE BASE, BILOXI, MISSISSIPPI

3.1.1.4 Rock-Type Formations

The geosyncline described above has a stratigraphic sequence comprising a massive wedge of transgressive and regressive episodes from the Tertiary and Quaternary periods overlying Cretaceous carbonate beds. These carbonate beds overlay Jurassic evaporites formed at the end of the Paleozoic era. Rapid sediment influx from the north and northeast has caused 250 miles of shelf edge progradation. Salt and shale domes perforate a clastic wedge, which was subsequently modified by broad regional folding and contemporaneous faulting. Recent Holocene deposits which have accumulated over the past 10,000 years are unconsolidated to poorly consolidated, sandy to muddy sediments (SOUTHDIVNAVFACENGCOM 1986a). Table 3.1.1.4-1 presents the stratigraphic column in the Mississippi Gulf Coast area since the Miocene epoch.

Materials of four geologic groups, the Graham Ferry, Citronelle, Pamlico Formations, and low terrace deposits are exposed in Harrison County. The Pamlico Formation underlies the Biloxi/Keesler AFB area. Biloxi, Gulfport, Long Beach, and Pass Christian are built on soils formed by recent beach deposits on the Pamlico Formation. The Pamlico Formation is also exposed at Deer, Ship, and Cat Islands (Smith 1975).

3.1.1.5 Sediment Characteristics

The sediment types in Mississippi Sound are shown in Figure 3.1.1.5-1. Lytle and Lytle (1985) reported slightly elevated total Kjeldahl nitrogen (TKN) and total organic carbon (TOC) levels in Biloxi Bay sediments, relative to TKN and TOC values in the open Sound. TKN values are indicative of organic compounds containing nitrogen, such as those released by fishmeal processing plants and sewage treatment plants. TOC measures all organic compounds, both natural and man-made. Typical natural levels of organic residues are 1 percent to 2 percent, thus, TOC values exceeding these levels indicate man-made organic contamination. Hydrocarbons and aromatic hydrocarbons, two other indicators of man-made organic pollution, were found in much higher amounts than ambient levels

Table 3.1.1.4-1. Geologic Formations, Mississippi Gulf Coast

Age	Formation	Lithology and Depositional Facies
Recent	--	Unconsolidated sands, silty sands, gravels, muddy sands, dark muds, peats (mainland beaches, barrier islands, inter-island shoals, sounds, bays, estuaries, river channels, swamps, marshes, oyster reefs)
Holocene	--	Same as Recent and sands of mainland barrier ridge complex (S. Hancock County)
Pleistocene (Sangamon Interglacial? Early Wisconsin Glacial)	Prairie	Semiconsolidated silty sands, fine and medium sands, sandy gravels, silts, peats (fluvial-alluvial complex)
(Sangamon Interglacial	Gulfport	Fine and medium sand, muddy fine sand dunes, beaches, shoreface mainland barrier ridges
(Sangamon Interglacial)	Biloxi	Semiconsolidated, often fossiliferous muddy fine sands, clayey fine sands, sandy muds (shallow nearshore marine)
Earlier Pleistocene (Interglacial? Glacial?)	Not defined	Silty sands, clayey sands, muddy sands, sandy muds, fine sands, some clay and peat (fluvial-alluvial complex)
Pliocene (-Preglacial Pleistocene?)	Citronelle	Sandy gravels, silty sands, fine and medium sands (fluvial-alluvial complex)
Miocene	Pascagoula ("Graham Ferry" not considered a separate formation above Pascagoula Fm)	Consolidated clays, silty clays, silty sands, fine sands, sandy muds (estuarine, fluvial, and lagoonal complex)

Sources: Otvos 1973; SOUTHDIVNAVFACENGCOM 1986a.

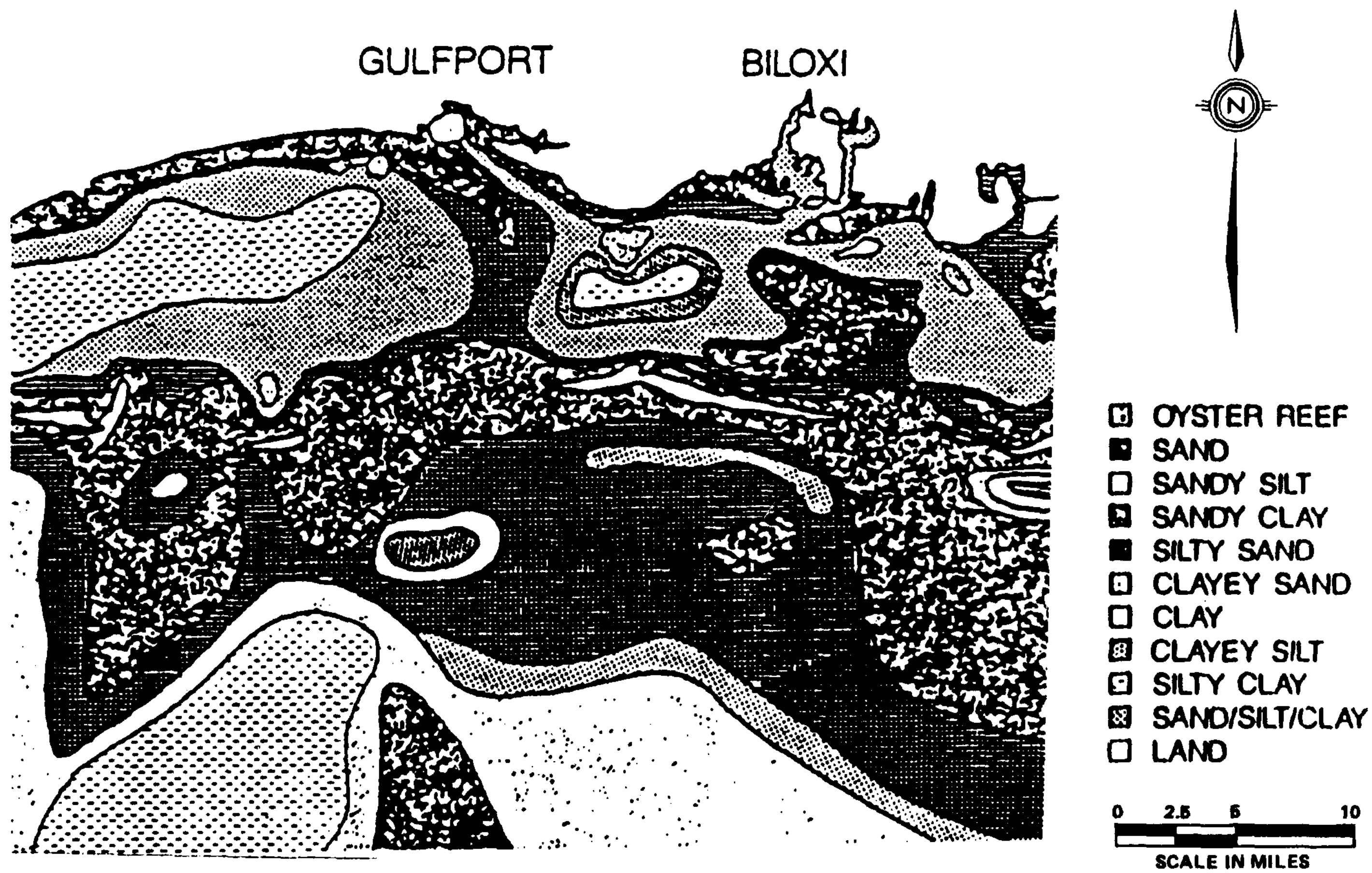


FIGURE 3.1.1.5–1. Sediment Types in Mississippi Sound near Keesler AFB

SOURCE: USACOE 1984b.
WAR 1989.

ENVIRONMENTAL ASSESSMENT OF THE RELOCATION OF A WEATHER TRAINING FACILITY TO KEESLER AIR FORCE BASE, BILOXI, MISSISSIPPI

in sediment samples taken from the open Sound. Sediments from the western portion of the open Sound, which receives water from Biloxi Bay, was found to have low levels of hydrocarbons, which could be both a reflection of the historic low levels of industrial activity in the area and an indication that pollutant levels in Biloxi Bay are relatively localized.

3.1.1.6 Natural Hazards

- Earthquakes: The Mississippi Gulf Coast lies in Zone 2 of the U.S. Coast and Geodetic Survey's scale of 0 to 3 in ranking the possibility of damage from earthquakes. However, an earthquake is unlikely to occur in this region because it is located in an inactive seismic zone. In other words, in the unlikely event that an earthquake occurred, damage would most likely be moderate. There are regular tremors in Louisiana, and the possibility exists that powerful, low-frequency tremors from Louisiana or other nearby territories could cause damage to the Mississippi Gulf Coast area (SOUTHDIVNAVFACENGCOM 1986a).

- Hurricanes: Hurricanes are specifically addressed in Section 3.1.2 (Regional Weather Patterns) under the heading of Hurricanes and Storms. Please refer to this section for a description of hurricanes and their effects on the Mississippi Gulf Coast area.

- Slope Instability: The Mississippi Sound area is characterized by broad expanses with little topographic relief. Terzaghi and Peck (1967) cite an example which implies that submerged sediment banks could exist at slopes of 8 to 9 percent, although such slopes would be close to the limit of stability. Sediments in Mississippi Sound do not approach this slope (NOAA 1984).

3.1.2 REGIONAL WEATHER PATTERNS

The Mississippi Gulf Coast has a subtropical climate, characterized by hot, humid summers and short winters. The region's mild climate is due in part to its latitude and in part to the heat storage capacity of the Gulf of Mexico (Eleuterius and Beaugez 1979).

3.1.2.1 Rainfall and Precipitation

The average annual rainfall at Keesler AFB has been 60.7 inches over a 44-year period. July is the wettest month with a mean rainfall of 6.8 inches. The driest month is October with an average rainfall of 2.7 inches. Measurable rain was recorded at Keesler AFB on an average of 108 days per year, while rainfall of more than 0.5 inch was observed on an average of 37 days per year. Thunderstorms are common in the summer months, occurring an average of 10 to 16 times monthly during June, July, and August.

Fog occurs frequently along the Gulf Coast, particularly during the winter months. Fog which reduces visibility to less than 7 miles occurs an average of 17 days per month in January and March, whereas similar conditions occur only 8 to 10 times per month between May and August.

Snow has been reported several times, always between September and March. The maximum amount of snowfall reported in a 24-hour period is 6 inches.

The average relative humidity at Keesler AFB is 80 percent at 6:00 a.m. Central Standard Time (CST), decreasing to 63 percent at noon CST (AWS 1986).

3.1.2.2 Temperature

The mean annual temperature recorded at Keesler AFB is 69°F. January is the coldest month with a mean temperature of 52°F, whereas July and August are the hottest months with average temperatures of 83°F. The

maximum recorded temperature is 104°F, although land-sea breezes usually act to keep temperatures below 100°F, by bringing cool maritime air inland. The lowest temperature which has ever been recorded on the base is 10°F.

The average date of the first freeze is December 12, and the average date of the last freeze is February 21 (SOUTHDIVNAVFACENGCOM 1986a). For the period 1942-1986, there were an average of 11 days per year with temperatures below 32°F and 48 days with temperatures above 90°F (AWS 1986).

3.1.2.3 Hurricanes and Storms

A hurricane is defined as a severe tropical storm with wind speeds in excess of 74 miles per hour (mph). The combination of wind, storm surge, and freshwater flooding generated by heavy rains can erode coastlines and accelerate deposition processes.

The wind force increases with the square of the wind speed. Factors affecting the amount of rain include the intensity of the storm, the speed of its forward movement, and its size. The size of the storm surge is governed by the following six factors (SOUTHDIVNAVFACENGCOM 1986a):

- The direction the hurricane is moving relative to the coastline (tides are typically greatest when the storm strikes perpendicularly to the coastline);
- The height of the tides produced by swells preceding the hurricane;
- The difference in barometric pressure between the eye of the storm and the surrounding atmosphere;
- The bottom slope, depth, and profile of the inner shelf and shoreface;
- The stage of the astronomical tide; and
- The shape of the coastline.

The storm surge creates extraordinarily high tides which are compounded by wave action. The powerful floodwaters generated by the storm surge usually cause the most damage.

Late summer/early fall hurricanes occur frequently along the Gulf Coast during a hurricane season which extends from June through October. Most storms occur in September (44 percent), August (15 percent), and October (15 percent). The probability of a tropical storm making landfall between Biloxi and Mobile Bay in a given year has been calculated at 13 percent, that of a hurricane at 6 percent, and that of a severe hurricane at 1 percent. However, the short Mississippi coastline is only crossed by an average of 19 tropical storms per century, with 8 of these being hurricanes.

Hurricanes and tropical storms which move inland in Alabama or Louisiana can also cause damage associated with high winds, high tides, or heavy rains. Since the winds are usually most severe in the northeast quadrant of the hurricane, hurricanes which strike southeast Louisiana can force high seas across Mississippi Sound. These storms can be as damaging as those which strike the Mississippi coastline. Hurricanes which make landfall in Alabama can cause much less damage in Mississippi, due to the less intense winds in their western portions (SOUTHDIVNAVFACENGCOM 1986b).

The Biloxi area has been affected by several hurricanes during this century, including the major storms of 1909, 1915, 1947, 1965, 1969 (Camille), and 1979 (Frederic). In recent years, Biloxi has been affected by hurricanes Bob, Danny, Elena, and Juan in 1985 (NOAA 1986) and Florence in 1988. Wind speeds during the 1906 and 1916 storms and Hurricane Frederic were greater than 100 mph, but probably less than 150 mph. The most devastating hurricane to strike the Mississippi Gulf Coast, Hurricane Camille, made landfall near Biloxi, in the Bay St. Louis-Waveland area. Wind speeds exceeded 200 mph and tidal elevations ranged from 24.2 feet in Bay St. Louis (Eleuterius and Beaugez

1979), to 16 feet at Biloxi (USACOE 1984a), to 20.1 feet in Gulfport, and to 11.2 feet in Pascagoula (SOUTHDIVNAVFACENGCOM 1986a). Normal tides average about 1.5 feet.

Keesler AFB was not flooded during the aftermath of Hurricane Camille in 1969. A railroad near the south side of the base acted as a natural berm protecting the base (Rackerd 1989). Since the storm surge during Hurricane Camille was the highest on record to strike the United States mainland, it is reasonable to assume that although the area could sustain major wind damage during a future hurricane, it is unlikely to be flooded by the storm surge of such a hurricane.

3.1.2.4 Waterspouts and Tornadoes

Tornadoes are reported infrequently along the Mississippi Gulf Coast. Because tornadoes tend to move from the southwest, any tornado affecting the study area would come from the direction of Mississippi Sound, where they do not develop readily. Waterspouts, however, have been reported and could cause damage upon moving inland (Bisso, et al. 1979).

3.1.2.5 Wind Characteristics

The prevailing winds are generally from a southerly direction during the summer months. During late fall and early winter, winds shift to the north, due to the influence of continental air masses (SOUTHDIVNAVFAC-ENGCOM 1986b).

Mean wind speeds average 4 to 6 knots at Keesler AFB. The highest recorded wind speed is 112 knots (AWS 1986).

3.1.3 SURFACE WATER

The waters of the State of Mississippi are divided into nine major basins (MBPC 1988). Keesler AFB is located within the Coastal Streams Basin. Mississippi Sound, Biloxi Bay, and St. Louis Bay are the major surface water features in the area.

3.1.3.1 Fresh Water

The area encompassing Biloxi drains into Mississippi Sound directly through the Biloxi and Tchoutacabouffa Rivers and their tributaries via Biloxi Bay. Other streams in the area include the Pascagoula River and the Pearl River which drain into Mississippi Sound, and Wolf River which drains into St. Louis Bay. Table 3.1.3.1-1 summarizes average daily streamflow statistics at streamflow gauging stations for streams discharging into Mississippi Sound, and Table 3.1.3.1-2 summarizes streamflow extremes.

The Coastal Basin encompasses all of Harrison County and portions of Hancock, Jackson, Stone, Lamar, and Pearl River Counties. It is bordered on the south by Mississippi Sound, on the northeast by the Pascagoula River Basin, and on the west by the Pearl River Basin (MBPC 1988).

The major water bodies in the Coastal Basin are monitored by the Mississippi Bureau of Pollution Control (MBPC) for water quality. A basin-by-basin analysis for quality of Mississippi waterbodies was conducted in 1988. The criteria used to assess the support of designated uses are summarized in Table 3.1.3.1-3. Both the Jourdan River and the Wolf River were found to be in compliance with all State water quality standards and met the qualifications to fully support their Fish and Wildlife classifications. The Tchoutacabouffa River and Tuxachanie Creek met the standards to support their Recreation classifications.

Very few bodies of freshwater are present on Keesler AFB and none are present at the site of the proposed Weather Training Facility.

3.1.3.2 Estuarine and Marine Water

Estuarine and marine waters in the vicinity of Keesler AFB and Biloxi include the Mississippi Sound and the Back Bay of Biloxi. Water characteristics of these two bodies of water are discussed in the following sections.

Table 3.1.3.1-1. Average Daily Streamflow Summary at Streamflow Gauging Stations on Streams Discharging into Mississippi Sound

USGS Station No.	Gauge Location	Tributary Drainage Area (sq. mi.)	Percent of Total	Years	Mean Average Daily Flow cfs	Mean Average Daily Flow in./yr.	Period of Record
PASCAGOULA RIVER AND TRIBUTARIES		9,498	48.8				
2479000	Pascagoula River at Merrill, MS	6,590	33.9	58	9,920	20.44	Oct. 1930-Sep. 1988
2479160	Black Creek near Wiggins, MS	701	3.6	17	1,397	27.06	Oct. 1971-Sep. 1988
2479300	Red Creek at Vestry, MS	441	2.3	30	860	26.48	July 1958-Sep. 1988
2479560	Escatawpa River near Agricola, MS	562	2.9	15	1,221	29.50	Aug. 1973-Sep. 1988
Gauged Subtotal:		7,031	36.2				
Ungauged:		2,467	12.7				
MISSISSIPPI SOUND INFLOW AND COASTAL AREA		1,272	6.5				
2481510	Wolf River near Landon, MS	308	1.6	17	657	28.97	Aug. 1971-Sep. 1988
2481000	Biloxi River at Wortham, MS	96	0.5	36	195	27.56	Oct. 1952-Sep. 1988
2480500	Tuxachanie Creek near Biloxi, MS	92	0.5	19	177	26.01	1952-1983, partial
Gauged Subtotal:		496	2.6				
Ungauged:		776	4.0				
PEARL RIVER		8,674	44.6				
2489500	Pearl River near Bogalusa, LA	6,573	33.8	50	9,822	20.29	Nov./1938-Sept./1988
Gauged Subtotal:		6,573	33.8				
Ungauged:		2,101	10.8				
GAUGED TOTAL:		14,101	72.5				
UNGAUGED TOTAL:		5,344	27.5				
TOTAL:		19,444					

Sources: USGS 1988.

Table 3.1.3.1-2. Summary of Streamflow Extremes at Streamflow Gauging Stations on the Streams Discharging into Mississippi Sound

USGS Station No.	Gauge Location	Period of Record	Extremes for Period of Record: Peak Discharge (cfs)	Date	Minimum Discharge (cfs)	Date		Trib Drainage Area (sq.mi.)
PASCAGOULA RIVER AND TRIBUTARIES								
2479000	Pascagoula River at Merrill, MS	10/1930-9/1988	178,000	2/27/61	696	11/3/36	898	6,590
2479160	Black Creek near Wiggins, MS	10/1971-9/1988	43,900	4/8/83	133	9/30/81	134	701
2479300	Red Creek at Vestry, MS	7/1958-9/1988	28,000	8/15/87	88	10/22/63	114	441
2479560	Escatawpa River near Agricola, MS	8/1973-9/1988	33,700	4/9/83	100	6/8/85	119	562
MISSISSIPPI SOUND INFLOW AND COASTAL AREA								
2481510	Wolf River near Landon, MS	8/1971-9/1988	18,400	4/8/83	37	6/9/85	44	308
2481000	Biloxi River at Wortham, MS	10/1952-9/1988	10,300	4/8/83	1.1	10/21/63	2	96.1
2480500	Tuxachanie Creek near Biloxi, MS	1952 to 1983, partial	17,700	—	1.6	—	3	92
PEARL RIVER								
2489500	Pearl River near Bogalusa, LA	10/1938-9/1988	129,000	4/24/79	1,020	10/29/63	1,170	6,573

Sources: USGS 1988.

Table 3.1.3.1-3. Water Quality Criteria for Intrastate, Interstate, and Coastal Waters, State of Mississippi

Water Usage	Bacteria	Specific Conductance	Dissolved Solids	Phenolic Compounds
Shellfish Harvesting Area*† (suitable for recreational purposes also)	Median fecal coliform MPN of the water 14/100 ml**			
Recreation† (water contact activities	Geometric mean of 200/100 ml††	1,000 umhos/cm for freshwater streams	750 mg/l as a monthly average value***	
Fish and Wildlife (suitable for incidental recreational contact also)	Geometric mean of 2,000/100 ml†††	1,000 umhos/cm for freshwater streams	750 mg/l as a monthly average value**	0.05 mg/l (phenol)

*Waters will meet the requirements in National Shellfish Sanitation Program, Manual of Operations, Part I, Sanitation of Shellfish Growing Areas, U.S. Public Health Service.
†Discharge of bacterially related wastewaters in or near waters of this classification will be considered by the State Commission with regard to its acceptability.
**Not more than 10 percent of the samples ordinarily exceed an MPN of 43 per 100 ml in those portions or areas most probably exposed to fecal contamination during most unfavorable hydrographic and pollutional conditions.
††More than 10 percent of the samples examined during any month shall not exceed 400/100 ml.
***Shall not exceed 1,500 mg/l at any time for freshwater streams.
†††More than 10 percent of the samples examined during any month shall not exceed 4,000/100 ml.

Sources: MBPC 1985.
SOUTHDIVNAVFACENGCOM 1986a.

3.1.3.2.1 **Salinity**—Salinities within Mississippi Sound are variable, as might be expected in a water body which receives fresh water from numerous sources along its northern boundary and salt water from the Gulf of Mexico along its southern boundary. Salinities in the Gulf range from 29 to 35 parts per thousand (ppt). Freshwater input into the Sound creates salinities ranging from 1 to 29 ppt. Salinities in the sound are inversely related to river flows and are higher in dredged channels (Eleuterius and Beaugez 1979).

3.1.3.2.2 **Tides and Currents**—Tides are a primary factor in the hydrography of the Mississippi Sound. Tides are predominantly diurnal (one high water and one low water per day). The average diurnal range (difference in water level from consecutive high and low water stages) varies from 1.5 feet at Pascagoula to 1.8 feet at Biloxi Bay (Eleuterius and Beaugez 1979). High and low tides do not occur simultaneously through the Sound. The phase shift can be as large as 6 hours. Tides occur first at Horn Island and Petit Bois Pass; 1 to 3 hours later at Mobile Bay, Dog Keys Pass, Ship Island Pass, and Ship Island Cut; and 4 to 6 hours later at Cat Island Channel. The circulation pattern induced by the tide is minimally dependent on the range of the tide, because all tidal constituents enter the Sound in the same area (USACOE 1984b).

Wind, along with the tides, strongly affects the general circulation pattern in Mississippi Sound. When winds are low, the tides naturally bifurcate at Horn Island Pass, south of Pascagoula Harbor, splitting the Sound into two regions. From Horn Island Pass to Mobile Bay on the east, tidal currents flow in through the passes and eastward on flood tide. From Horn Island Pass to the western boundary of the Sound at Lake Borgne, tidal currents flow in through the passes and westward on flood tide. During ebb tide, these flows reverse direction.

Under sustained winds, a wind-induced current shifts this bifurcation point in the direction of the east-west component of the wind during

flood tide and in the opposite direction during ebb tide. Modeling has indicated that little effect on the general circulation pattern is induced by winds with a dominant north-south component. Current vortices in shallower waters, particularly to the east of Dog Keys Pass, might be induced by such a wind, but the overall effect would be minimal. A sustained 15-mph wind from the south will create eddies throughout the Sound, while a sustained 15-mph wind from the north will induce weaker eddies (USACOE 1984b).

Current speeds in the Mississippi Sound range from 0 to 0.8 feet per second (fps). Current speeds in the passes range from 0 to 3 fps. These speeds increase as much as 40 percent with an increase of 1 foot in the range of tides. Sustained easterly winds increase current speeds from Mobile Bay to Biloxi, whereas westerly winds increase current speeds in the western part of the Sound. Effects caused by north-south winds are usually small and localized. Tidal elevations in portions of the bay can be increased or decreased by wind-pushed water (USACOE 1984b). Wind-induced water surface elevations reached as high as 24.2 feet msl national geodetic vertical datum (ngvd) at Pass Christian during Hurricane Camille in 1969 (Eleuterius and Beaugez 1979).

3.1.3.2.3 **Water Quality**--Fecal coliform levels have been a concern in Mississippi Sound in the past, due to improperly treated wastewater and urban runoff. The MBPC and the Mississippi Department of Health conduct weekly bacterial studies each summer in swimming areas along the Mississippi Gulf Coast. No closures of bathing areas or surface water drinking supplies, and no incidences of waterborne disease were reported in 1988 (MBPC 1988). Improvements in wastewater treatment are cited for the downward trend in fecal coliform levels in Mississippi Sound over the past decade.

The construction of a new municipal sewage treatment plant at Ocean Springs has improved estuarine water quality near Biloxi, particularly

in Ocean Springs Small Craft Harbor and in Biloxi Bay. The previous facility had been discharging a poor quality effluent into Ocean Springs Harbor. Sewage is now diverted to a facility which has no discharge to surface waters. Significant positive changes in the water quality were observed after the new facility began operation. Inorganic nutrient concentrations and biological oxygen demand values decreased in the harbor. Fecal coliform bacteria counts dropped to levels commensurate with those in surface water runoff entering the harbor, and dissolved oxygen concentrations increased at all stations (MBPC 1988).

The following municipalities upgraded their waste treatment facilities during 1986 and 1987 to meet water quality criteria: Biloxi, Moss Point, Ocean Springs, and Pascagoula. New facilities were recently completed at D'Iberville and Gautier. Construction was underway for new treatment plants in Waveland/Bay St. Louis, Pass Christian/Long Beach, and Gulfport (MBPC 1988).

Major estuarine water bodies in the Coastal Basin are also monitored by the MBPC for water quality. Back Bay of Biloxi at Ocean Springs fully supports its use classification, Fish and Wildlife, but it is threatened by nutrients from municipal discharges, urban runoff, and septic tanks. Back Bay of Biloxi at Popps Ferry is considered to be partially supporting the uses of the Fish and Wildlife classification, due to organic enrichment, nutrients from municipal discharge, urban runoff, and septic tanks. Industrial discharges were cited as a potential source of toxicity (MBPC 1988).

A study of the nutrient distribution in Mississippi Sound was conducted by Eleuterius (1976). The Biloxi/Gulfport area appears to have been the major source of low oxygen concentrations, and Biloxi also seems to have been a primary source of nitrates. The spatial distribution of nutrients is expected to remain similar to that reported by Eleuterius, although levels are expected to be reduced.

A list of National Pollutant Discharge Elimination System Permits for the Biloxi area was acquired for this report. No permitted waste discharges to Mississippi Sound occur from Harrison County, Mississippi (Morris 1989).

3.1.4 GROUNDWATER

The sediments of coastal Mississippi, which have been deposited since the Miocene period, dip southwest as a result of the Gulf Coast Geosyncline, an early Cenozoic structural basin. The water-bearing properties of these geologic units have been exploited since the late 19th century, when the first deep wells in the area were drilled (SOUTHDIVNAVFACENGCOM 1986b).

As indicated in Table 3.1.4-1, the Miocene and Pliocene sediments are, in order of descending age, Catahoula Sandstone, Hattiesburg Formation, Pascagoula Formation, Graham Ferry Formation, and the Citronelle Formation. The Citronelle Formation is the youngest and most extensive of the Pliocene and Miocene sediments. Aquifers within the Citronelle Formation are disjunct and hydrologically independent. Exposed beds may occur on hilltops or in eroded stream valleys, sometimes along with the underlying Miocene beds. Since the Citronelle Formation is located near the surface, it can be contaminated by landfills, sewage, and industrial and oil field wastes. Dissolved solids concentrations are less than 500 mg/l, except in areas where sea water contacts the aquifer. The Citronelle, like other Pliocene and Miocene sediments, can be areally discontinuous and variable in thickness (SOUTHDIVNAVFACENGCOM 1986a; Sumner, et al. 1987).

The Citronelle Formation dips into the subsurface near the coast and becomes the upper part of the Miocene aquifer system, which also includes the Pascagoula and Hattiesburg Formations, and the Catahoula sandstone. The Graham Ferry Formation, located beneath the Citronelle Formation, is the source of most of the fresh groundwater used in the

Table 3.1.4-1. Geologic Units and Their Water-Bearing Properties (Page 1 of 2)

System	Series	Formation	Thickness (feet)	Lithology and Stratigraphy	Hydrology
Quaternary	Holocene	Alluvium	20-80+	Clay, silt, sand and fine gravel.	Contains water that is probably salty as far north as salt water penetrates up the rivers.
	Pleistocene	Terrace deposits	0-100	Sand and clay grading downward into coarse sand and fine gravel.	Contains fresh water having a low dissolved-solids content. Near the coast at shallow depths, the water is subject to salt water encroachment.
	Pliocene	Citronelle	0-100+	Sand and gravel.	Maintains high base flows of streams, and a source of recharge to the Miocene aquifer system. Supplies most rural wells in uplands.
		Graham Ferry	0-200	Gray, carbonaceous, and fossiliferous clay and lenticular sand, in places coarse but usually fine to medium.	Supplies 60 percent of the municipal and industrial groundwater supply, soft sodium bicarbonate type of water.

Table 3.1.4-1. Geologic Units and Their Water-Bearing Properties (Page 2 of 2)

System	Series	Formation	Thickness (feet)	Lithology and Stratigraphy	Hydrology
Tertiary	Miocene	Pascagoula	250-1000+	Clay, shale, and sand. Sand is lenticular, fine to very coarse.	Comprises several aquifers along the coast and many sand beds of local extent. The base of fresh water is in the lower part of the formation. Where the thickness is substantial, transmissivity is high. Soft, sodium bicarbonate type of water, usually having higher chloride content than Graham Ferry Formation.
		Hattiesburg	850+	Clay and sand similar to Pascagoula Formation.	Contains supplies of fresh water in counties north of coastal area.
		Catahoula Sandstone	300+	Sand, shale, and sandstone.	Unused. Saline water.

Source: Colson and Boswell 1985.
SOUTHDIVNAVFACENGCOM 1986a.

Gulf Coast area (Colson and Boswell 1985; SOUTHDIVNAVFACENGCOM 1986a). The depth at the base of the freshwater zone increases from 1,200 feet east of Pascagoula to more than 2,400 feet near Gulfport. Aquifer recharge is from rainfall on the outcrop, seepage from the overlying Citronelle Formation, and leakage between aquifers within the Miocene system (SOUTHDIVNAVFACENGCOM 1986a).

The artesian pressure in Gulf Coast aquifers has declined significantly during this century. The first flowing artesian well in the area is reported to have been drilled in 1884 (Colson and Boswell 1985). Prior to that time, water levels in the aquifers varied according to the season, but remained fairly constant from year to year. Water levels have declined as much as 100 feet in several aquifers along the coast since the area was first developed. Large withdrawals from the aquifer system have caused cones of depression around pumped wells. These cones have deepened, expanded, and overlapped over time to form troughs of depressed water in several layers of the Miocene aquifer system along the coast. As a result, the depressed potentiometric surfaces in these layers have allowed saline water to move toward the pumping centers (Sumner, et al. 1987).

Heavy pumpage increases the potential for saltwater intrusion. A quasi-three-dimensional numerical model of the Gulf Coast groundwater flow system was constructed and calibrated by Sumner, Wasson and Kalkhoff (1987). Additional water-level declines in the Biloxi area were projected to reach 50 to 100 feet in the Biloxi-Gulfport area. The most serious threat of saltwater encroachment was projected to be in the Pascagoula area where saline contamination of the southern edges of the production areas is expected within 10 years.

Saltwater intrusion also contaminates shallow, unconfined aquifers which are in hydraulic connection to coastal streams. Movement of these salt-water wedges is accelerated by deepening of coastal channels (SOUTHDIV-NAVFACENGCOM 1986a).

3.1.5 AIR QUALITY

Biloxi is in the Mobile-Pensacola-Panama City-Southern Mississippi Interstate (Alabama-Florida-Mississippi) Air Quality Control Region. The 1988 Air Quality Report was not available, but Mississippi was reported (Simmons 1989) to be in attainment for all federal and state standards. Table 3.1.5-1 indicate the results of the 1987 Air Quality Report.

The Biloxi area is principally affected by gaseous and particulate emissions from industrial and manufacturing sources. Vehicular sources also contribute to contaminant emissions. Sources of emissions listed in the State of Mississippi Enforcement Management System (MBPC 1989) are identified as major or minor. No major sources are listed in Biloxi or the neighboring city of Ocean Springs. Gulfport lists several major sources, including Necaise Construction Company, Inc., Williams Paving Company, Mississippi Power Company (J. Watson Plant), Indal Aluminum, Bond Paving Company, Inc., and Reichhold Chemical Corporation.

Standards for fine particulate air quality were revised in mid-1987. The new standard is based on a unit known as PM10, the concentration of particles less than 10 microns, measured in micrograms per cubic meter. The previous standard for particulate air quality, total suspended particulates (TSP), is now used as a surrogate measure of air quality. Used in this role, no TSP monitors operated by the MBPC detected particulate levels threatening the PM10 standard or the former TSP standard. Three TSP monitors were operated on the Gulf Coast, two in Gulfport and one in Pascagoula. The only PM10 monitor in Mississippi is located in Jackson and is in compliance with EPA standards (MBPC 1987).

3.1.6 NOISE

Noise is generally defined as unwanted sound. This definition implies a subjective judgement regarding whether a sound is noisy relative to the

Table 3.1.5-1. National Ambient Air Quality Standards

Pollutant	Time Frame	Primary Standards	Secondary Standards	Measured Levels at Gulf Coast Stations
PM_{10}*	Annual (arithmetic mean)†	50 ug/m^3		Not tested
	24-hour max.	150 ug/m^3**		
Sulfur Oxides	Annual (arithmetic mean)†	0.03 ppm††		Below standard
	24-hour max.	0.14 ppm**		
	3-hour max.		0.5 ppm**	
Carbon Monoxide	8-hour max.	9 ppm**		Not tested
	1-hour max.	35 ppm**		Below standard
Ozone	1-hour max.	0.12 ppm***		Not tested
Nitrogen Dioxide	Annual (arithmetic mean)†	0.053 ppm		
Lead	Quarterly (arithmetic mean)†	1.5 ug/m^3		Not tested

*Particulate matter less than 10 microns in diameter
†Arithmetic mean is a measure of central tendency found by summing data collected in a given period and dividing by number of observations in same period.
**Not to be exceeded more than once per year.
††Parts per million.
***To be exceeded no more than one day per year based upon a 3-year average.

Source: MBPC 1987.

surrounding environment. Thus, the setting in which a sound is heard plays a large role in whether it is perceived as acceptable. For example, sounds which are not considered disruptive during daytime hours may be intrusive during the quieter nighttime hours. Table 3.1.6-1 depicts typical noise levels emitted from common urban sources, which may be used as a point of reference when discussing noise sources. These figures are reported in A-weighted decibels (dBA). The use of the A-weighted scale indicates that the response of the sound level meter was filtered to simulate the overall response of the human ear.

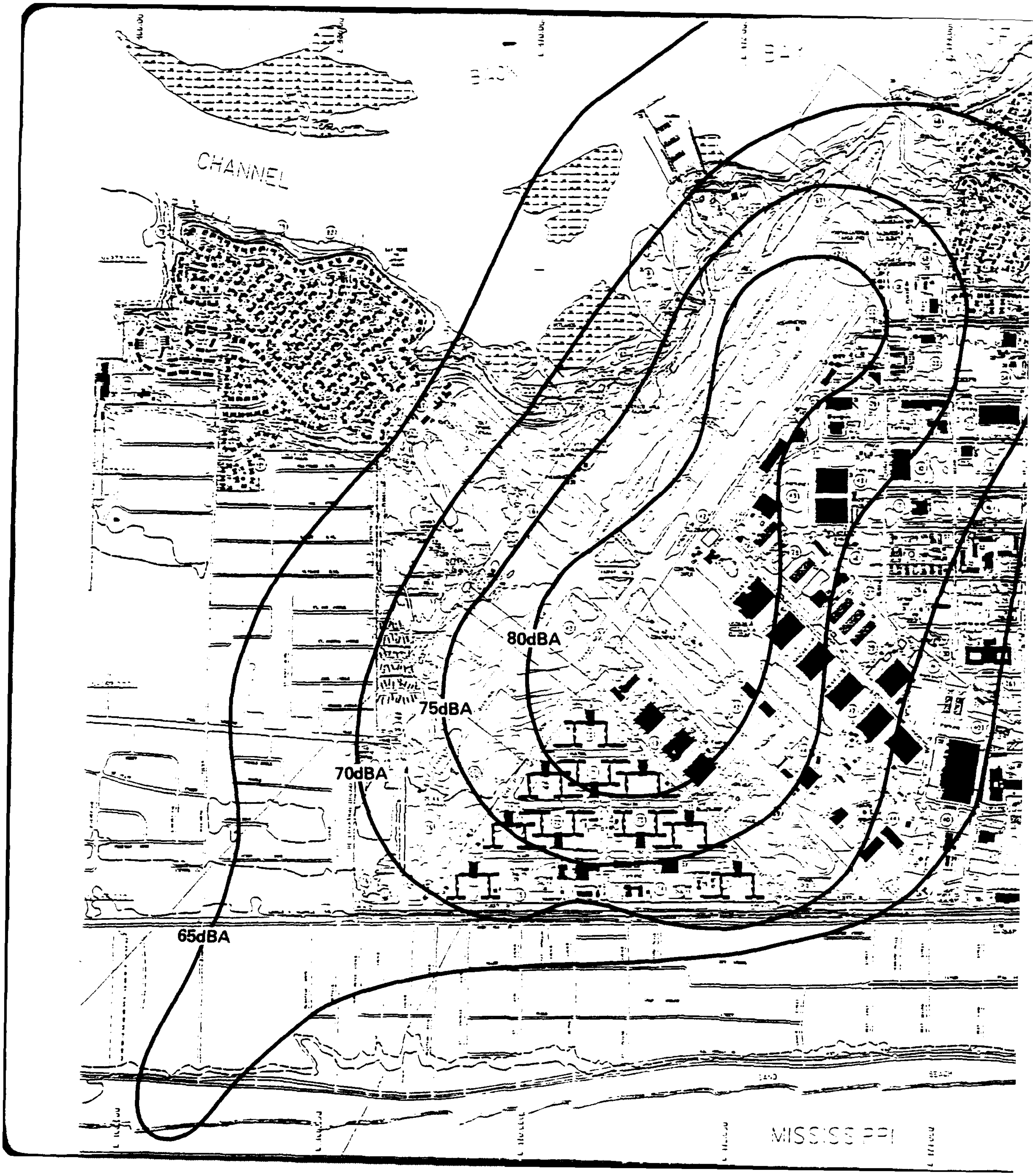
Keesler AFB is located near Highway 90. Noise levels along Highway 90, the major artery for traffic approaching the base, are affected by traffic levels, industrial and construction activities along the highway, and wave noise along the beach. Specific noise data along Highway 90 were not available, but levels are expected to be characteristic of urban centers, or approximately 60 to 65 dBA.

The proposed site of the Weather Training Facility and the dorm/dining hall renovation sites on Keesler AFB are located within 2,000 feet of an active runway. Noise contours in the vicinity are illustrated in Figure 3.1.6-1. Noise levels at the sites are approximately 75 dBA.

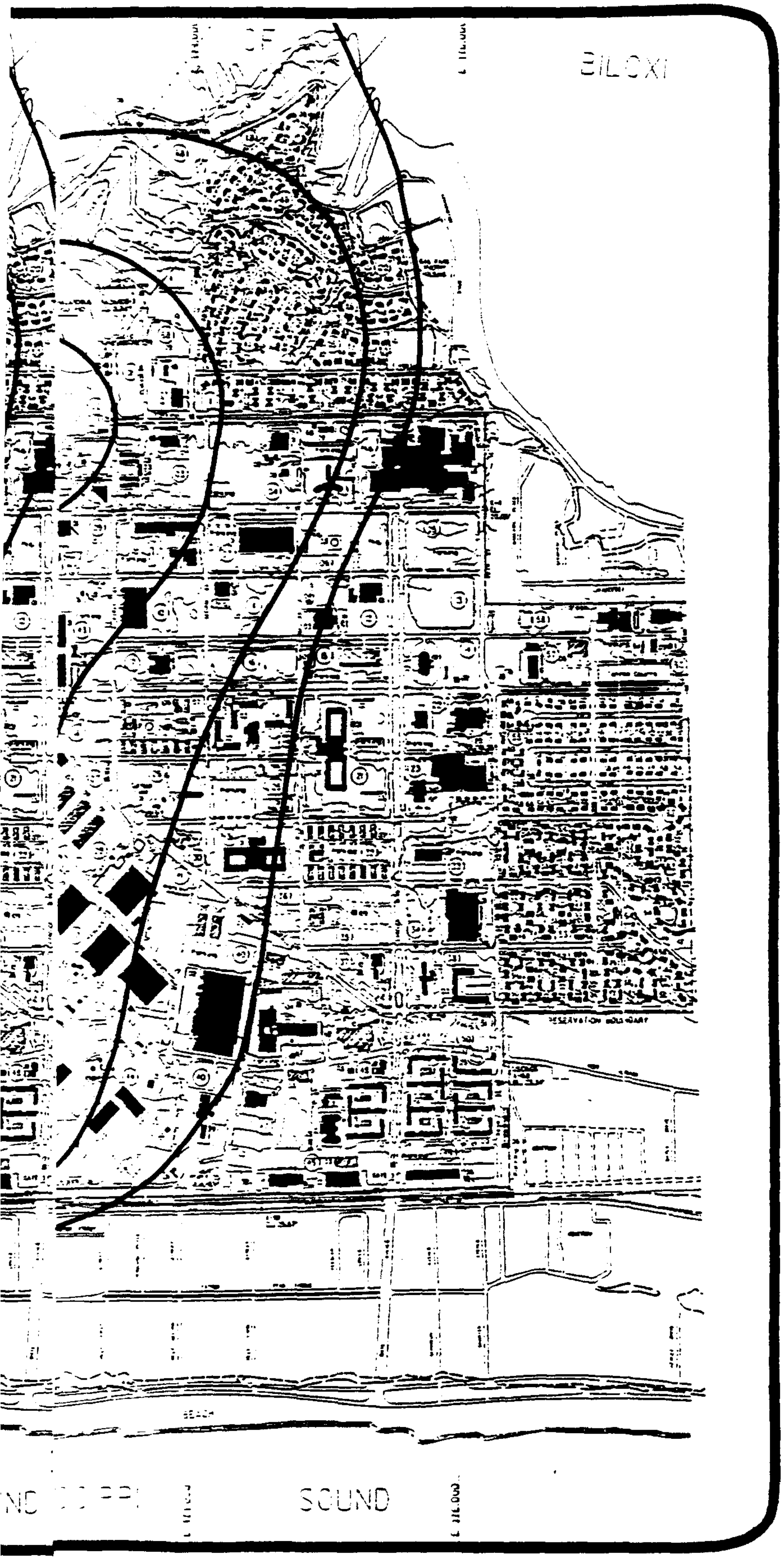
The NEXRAD facility is to be located on military property in the De Soto National Forest just southwest of the firing range. The nearby state highway (Highway 67) would be expected to generate low noise levels in ad tion to the noise generated from the firing range when it is in active use.

3.2 BIOLOGICAL SYSTEMS

Mississippi lies mainly in the East Gulf Coastal Plain, with the exception of the uplifted northeastern corner. The Biloxi/Keesler AFB area is located in the Lower Coastal Plain physiographic province. Elevations in this region increase gradually from sea level along the



CHANNEL
80dBA
75dBA
70dBA
65dBA
MISSISSIPPI



ENVIRONMENTAL ASSESSMENT OF THE RELOCATION OF A WEATHER TRAINING FACILITY TO KEESLER AIR FORCE BASE, BILOXI, MISSISSIPPI

FIGURE 3.1.6–1. Noise Contours at Keesler AFB, Biloxi, Mississippi

SOURCE: USAF 1987.
WAR 1989.

Table 3.1.6-1. Noise Levels Emitted from Various Common Urban Sources

Equipment/Process	Average Noise Level (dBA)*
Automobile	73†
Backhoe	85
Bulldozer	87
Bus	82
Compressor	81
Concrete mixer	85
Front-end loader	79
Generator	78
Grader	88
Jackhammer	88
Light truck	72
Loaders	79
Locomotive	94
Medium- or heavy-duty truck	84**,95††
Motorboats	80
Motorcycle or minicycle	82-85
Paver	89
Pile driver	101
Pneumatic tool	86
Pump	76
Scraper	88
Tractor	80
Truck	91
Backfill and cleanup	87(89)***,†††
Clearing	75(86)***,†††
Grading	78(84)***,†††
Trenching	88(92)**,†††
Welding	77(87)***,†††

*At 50 feet for construction equipment and vehicles, at "edge of right-of-way" for onshore construction processes.
†Includes sports cars, compacts, and standard passenger cars (Berkau et al., 1975).
**Below 35 mph (Berkau et al., 1975).
††Above 35 mph (Berkau et al., 1975).
***Numbers in parentheses indicate maximum dBA.
†††Source: New England River Basins Commission 1976.

Source: Bolt, Berenek, and Newman, Inc. 1971;
SOUTHDIVNAVFACENGCOM 1986b.

coast to a maximum of about 30 meters in the northern area. This gradual change in topography results in relatively uniform vegetation types and wildlife habitats throughout the region (Lohoefener & Altig 1983). Habitats include urban areas, woodlands, rivers and small lakes, and salt and freshwater marshes.

3.2.1 VEGETATION

Floristically, Mississippi has been divided into 10 regions with the Biloxi/Keesler AFB area in the Coastal Pine Meadows region. This is a low-lying region of slight relief. Groundwater lies near the surface and forms marshes and swamps. The streams which flow through this region are sluggish and sinuous with sandy bottoms and clear, amber-colored, peaty water (Lowe 1921).

3.2.1.1 Terrestrial Flora

The terrestrial flora in the region surrounding the Biloxi/Keesler AFB area is primarily an open growth of pine with an undergrowth resembling that of the northern bogs in the wetter, more acidic areas. Floristically, it is one of the most interesting regions in the state and possesses more species unique to the area than any other. Within the region are found sandy beaches, coastal dunes, brackish marshes, lakes, streams, and upland areas.

3.2.1.1.1 Description—The vegetation of the beaches is characterized by pioneer plants able to establish themselves in the shifting sand. These plant communities expend considerable energy in adapting to the severe stresses of shifting sands, a highly saline environment, and high winds. The salt spray retards succession indefinitely at a grass or shrubby stage.

The dune association is dominated by plant species which tolerate saline sands of very low organic content. Pennywort (*Hydrocotyle* sp.), sea oats (*Uniola* sp.), and morning glory (*Ipomea* sp.) typically occur in this plant association.

The maritime strand is, in essence, a modified, longleaf pine-oak association with fewer plant species. Species of the maritime strand association are able to tolerate high winds and salt spray. Maritime forests are usually located immediately landward of the dune association. Scrub live oak (*Quercus virginiana* var. *maritima*), myrtle oak (*Quercus myrtifolia*), and slash pine frequently dominate the maritime strand association (USACOE 1984b).

In lower, more hydric areas the pineland association dominates. The moist pinelands, dominated by slash pine (*Pinus elliottii*), often form an intermediate strip between swamps and upland pine-oak forests. In the absence of fire, the moist pinelands develop a very dense understory.

Upland forests of the coastal Mississippi mainland consist of longleaf pine-oak, moist pineland, dune, and maritime strand associations. In many cases, pine plantations have replaced the natural upland vegetation communities.

Xeric sandy sites above the 10-foot contours are usually dominated by the longleaf pine-oak association (USACOE 1984b). Periodic ground fires maintain open areas and prevent the invasion of hardwoods.

Smith (1975) reported that a total of 285,600 acres (76 percent) of Harrison County is covered by longleaf-slash pine forest (64 percent), loblolly-shortleaf pine forest (7 percent), oak-pine forest (16 percent), oak-hickory forest (4 percent), and oak-gum-cypress forest (9 percent). Although trees of the dominant forest types occur throughout the City of Biloxi, undisturbed forested areas do not exist within the city (Bisso, et al. 1979).

Trees existing on Keesler Air Force Base include:

Live Oak	*Quercus virginiana*
Red oak	*Quercus falcata*

Water oak	_Quercus nigra_
Shumard oak	_Quercus shumardi_
Willow oak	_Quercus phellos_
Sweet gum	_Liquidambar styraciflua_
Tulip tree	_Liriodendron tulipifera_
Southern magnolia	_Magnolia grandiflora_
Slash pine	_Pinus elliottii_
Red cedar	_Juniperus silicicola_
Black willow	_Salix nigra_
Red maple	_Acer rubrum_

Numerous species and varieties of nursery-grown trees, shrubs, and grasses planted on the base are listed in the Keesler AFB Land Management Plan (USAF 1988). Ground cover on the base consists primarily of bermuda grass, centipede grass, and St. Augustine grass.

The proposed site of the Weather Training Facility on Keesler AFB is presently a paved parking area with two live oaks on the margin. The proposed site for the NEXRAD radar installation is a partially cleared open pine forest area southwest of the firing range.

3.2.1.1.2 **Threatened and Endangered Species**—Although the Mississippi Natural Heritage Program (MNHP) does not provide formal legal protection for plants, special status has been given to upland and coastal plant species listed in Table 3.2.1.1.2-1. None of these species are protected under federal legislation and none are known to be present on the construction/renovation sites associated with the relocation of the Weather Training Division to Keesler AFB.

3.2.1.1.3 **Unique Plant Communities**—There are no known unique plant communities in the vicinity of the proposed site for the Weather Training Facility or the proposed site of the NEXRAD radar installation.

3.2.1.2 Freshwater Flora

Freshwater habitats are limited on Keesler AFB since most of the base has been developed. Freshwater plant communities include marshes (non-forested) and swamps (forested).

3.2.1.2.1 Description—Freshwater marshes occur in isolated areas along the Biloxi River where banks are steepest. These areas are dominated by Eleocharis cellulosa, Eleocharis obtusa, Crinum americanum, Saururus cernuus, Sagittaria lancifolia, Pontederia cordata, Scirpus validus, Rhynchospora macrostachya, and Juncus megacephalus, among many others. Juncus roemerianus and brackish water species are absent.

Forested wetlands are primarily associated with the floodplains of rivers and streams at higher elevations than freshwater marshes. Dominant vegetation depends upon the water depth and duration of flooding. Where flooding is extensive, bald cypress (Taxodium distichum) and swamp tupelo (Nyssa aquatica) tend to dominate.

No freshwater habitats are present at the proposed site for the Weather Training Facility or on the site of the NEXRAD radar installation.

3.2.1.2.2 Threatened and Endangered Species—Freshwater plants which have been given special status by the MNHP are listed in Table 3.2.1.1.2-1. Due to the lack of freshwater habitats at any of the construction/renovation sites associated with the proposed action, there are no known threatened or endangered species present at the sites.

3.2.1.2.3 Unique Plant Communities—There are no known unique plant communities or habitats preser at the Weather Training Facility or NEXRAD radar installation sites.

3.2.1.3 Marine Flora

The marine flora of Coastal Mississippi is found on the barrier islands and immediately along the coast adjacent to the shoreline. Since the

Table 3.2.1.1.2-1. Threatened and Endangered Plants of Coastal Mississippi

Scientific Name	Common Name	Status State	Status Federal	Habitat
Canna flaccida	Golden Canna	CI	—	Pine marshes
Conradina canescens	Seaside Balm	CI	—	
Elionurus tripsacoides	Pan American Balsam Scale	SU	—	
Eulophia ecristata	Smooth-lipped Eulophia	CI	C2	Dry grassy areas
Ilex amelanchier	Juneberry Holly	R	C2	Wooded stream banks
Lachnocaulon digynum	Bog Buttons	I	C2	
Lilaeopsis carolinensis	Carolina Lilaeopsis	I	C2	Open mud flats
Magnolia tripetala	Umbrella Tree	CI	—	Rich woods
Pieris phillyreifolia	Climbing Fetterbush	CI	C3	Cypress and Ilex ponds
Pinguicula planifolia	Chapman's Butterwort	I	C2	Black peat in cypress domes
Platanthera integra	Yellow Fringeless Orchid	R	C3	
Rhododendron austrinum	Florida Flame Azalea	I	C3	Moist, wooded slopes
Rhynchospora tracyi	Tracy's Beak Rush	CI	—	Cypress swamps
Ruellia noctiflora	Night-flowering Ruellia	R	—	
Sageretia minutiflora	Tiny-leaved Buckthorn	I	C3	Sand dunes
Sarracenia purpurea	Pitcher Plant	CI	—	Sphagnum bogs
Schwalbea american	Chaffseed	CI	C2	Pine woodlands
Xyris drummondii	Drummond's Yellow-eyed Grass	I	C2	Wet pine barrens
Xyris flabelliformis	Fan-shaped Yellow-eyed Grass	SU	—	Moist savannahs
Xyris scabrifolia	Harper's Yellow-eyed Grass	CI	C2	Wet pine barrens

C2 = Category 2 - Under review for listing, but substantial evidence of biological vulnerability and/or threat is lacking.
C3 = Category 3 - Species is more abundant and/or widespread than previously believed.
T = Threatened
E = Endangered
R = Rare
S = Species of special concern
I = Imperiled
CI = Critically Imperiled
SU = Status Uncertain

Source: Mississippi Natural Heritage Program 1989.

Weather Training Facility, NEXRAD radar installation, and Dorm/Dining Hall renovation sites are all located in upland areas, the following text is limited to a description of the marine flora in the vicinity of Keesler AFB only.

3.2.1.3.1 **Description**—Brackish and saline marshes dominate the coastal wetland vegetation associations of Mississippi. Species distribution is primarily controlled by hydroperiod (degree of inundation).

Black needlerush (*Juncus roemerianus*) and smooth cordgrass (*Spartina alterniflora*) dominate saline marshes (areas that are most frequently inundated by salt water). Black needlerush is prevalent in saline marshes, whereas smooth cordgrass is locally abundant in the intertidal zone at the marsh fringe. Sea lavender (*Limonium nashii*) and saltmarsh aster (*Aster tenuifolius*) are often sparsely distributed throughout saline marshes. Salt flats within the saline marshes usually support salt-tolerant species such as *Distichilis spicata*, *Salicornia bigelovii*, *Sueda linearis*, and *Batis maritima*.

Brackish marshes usually harbor more plant species than saline marshes. Brackish marshes are dominated by black needlerush and saltmeadow cordgrass (*Spartina patens*). Saltmeadow cordgrass usually forms a band between black needlerush and upland shrubs. Many freshwater plant species are able to tolerate low salinities. These species include cattails (*Typha* spp.), bulrushes (*Scirpus* spp.), sawgrass (*Cladium jamaicense*), and spikerush (*Eleocharis* spp.). Olney's three-square (*Scirpus olneyi*) is limited to upland fringes receiving significant freshwater runoff.

Grassbeds are colonies of rooted vascular plants and attached macrophytic algae living below the water surface. Along the Mississippi coast, they are found primarily on the north side of the barrier islands separating Mississippi Sound from the Gulf of Mexico. All vascular

plant and attached algae habitats occur in shallow water (depth at mlw, 2 to 6 feet). In the early 1970s, approximately 20,000 acres in Mississippi Sourd contained submerged attached vegetation primarily consisting of turtle grass (Thalassia testudinum), manatee grass (Syringodium filiforme), (Halophila engelmanii), and shoal grass (Halodule beaudettei) (Eleuterius 1971). Eleuterius (1971) found Ruppia maritima along muddy shores in shallow bays and bayous in less than 3 feet of water and also in low salinity lagoons on the barrier islands. Vallisneria americana occurred in low salinity bayous in less than 3 feet of water in the rivers of the mainland. With the exception of shoal grass, which grows on hard sand bottoms, the vascular plant species of Mississippi Sound prefer soft muddy substrates. All of these plants support a variety of algal species on the upper portions of the leaves. Dominant, attached algal genera include Fosliella, Archrochaetium, Ectocarpus, and Hypnea (Humm and Caylor 1957).

Approximately 6,000 acres of submerged attached vegetation were destroyed by Hurricane Camille in 1969, but some of this acreage had reestablished by 1972. Many of the grassbeds were destroyed in 1973 when extremely high freshwater discharges from the Mississippi River produced drastically reduced salinity and increased turbidity in Mississippi Sound over extended periods of time (SOUTHDIVNAVFACENGCOM 1986a). Drought years may actually favor the recolonization of these areas (Eleuterius and Miller 1976).

Of the 77 algal species known to occur in the area, approximately one-third occur on sandy substrates, attached to shells, or to the blades and exposed rhizomes of seagrasses. The remainder of the species attach to "artificial" solid substrates provided by man, such as pilings and various materials used for shore stabilization. Thus, the paucity of benthic algae within the study area is due primarily to the lack of suitable substrate for attachment (Humm and Caylor 1957).

Phytoplankton in Mississippi Sound is dominated by the Bacillariophyceae (diatoms) and Dinophyceae (dinoflagellates). Diatoms are most abundant in winter and spring due to the availability of nutrients, whereas dinoflagellates are most productive during the warmer summer months (Bellis 1974). The phytoplankton community within the Sound is depauperate (USACOE 1984b). Although phytoplankton productivity may be very high in estuaries, diversity can be very low. Estuarine phytoplankton data indicate that high nutrient levels cause enhanced production of a few opportunistic algal species (Hulburt 1963). Steidinger (1973) explained that the opportunistic species establish in very high numbers, and consequently, diversity is reduced.

3.2.1.3.2 **Threatened and Endangered Species**—There are currently no threatened or endangered marine species listed for Mississippi.

3.2.1.3.3 **Unique Plant Communities**—There are no known unique plant communities of marine species in the vicinity of Keesler AFB.

3.2.2 WILDLIFE

Because of the diversity of habitats in the coastal region, a diversity of wildlife is also found in the region. The following sections will discuss the terrestrial, freshwater, and marine fauna of Keesler AFB and the Mississippi coastal region.

3.2.2.1 Terrestrial Fauna

Much of Keesler AFB has been developed by construction of buildings or paving of areas for runways or parking. This amount of construction has limited the amount of wildlife found on the base. Discussions of the wildlife and habitats remaining on Keesler AFB and in the surrounding region will include discussions of commercial species, threatened and endangered species, and unique and critical habitats in the area.

3.2.2.1.1 Mammals--The raccoon (Procyon lotor varius) and the opossum (Didelphis marsupialis) are among the most common mammals along the Mississippi coast. The rice rat (Oryzomys palustris palustris) commonly occurs in salt marshes, feeding on the abundant grass and sedge seeds. Although the cotton rat (Sigmodon hispidus hispidus) occasionally feeds in the saltmarshes, it primarily inhabits grassy fields above the shoreline. Introduced exotic species include the house mouse (Mus musculus), black rat (Rattus rattus), Norway rat (Rattus norvegicus), the nine-banded armadillo (Dasypus novemcintus), and nutria (Myocastor coypus). Armadillos usually burrow in dry sandy areas, whereas nutria inhabit both freshwater and saltwater marshes (O'Neil and Mettee 1982).

Coastal mammals possibly found at Keesler AFB are listed in Table 3.2.2.1.1-1 (Burt, et al. 1976; USACOE 1984b). Most of the mammals present on-site are adapted to urban conditions. These species include the raccoon, rice rat, cotton rat, black rat, Norway rat, and the house mouse.

Since the NEXRAD construction site is adjacent to the U.S. Air Force firing range, the local wildlife community is probably dominated by species which prefer "edge" habitat. Typical species would include the eastern cottontail rabbit, raccoon, armadillo, bobcat, and quail. Arboreal species such as the fence lizard and gray squirrel are probably common. Because the NEXRAD construction site is in proximity to a large expanse of forested land, many wildlife species are likely to inhabit or migrate through the area. However, species that are sensitive to human disturbance may not inhabit the area because of activities at the firing range.

3.2.2.1.2 Birds--Table 3.2.2.1.2-1 lists birds that are known to occur in and along the coast of Mississippi (Toups and Jackson 1987). Incidental and unconfirmed sightings are not included. Some of the common passerine species of coastal Mississippi include the Boat-tailed

Table 3.2.2.1.1-1. Terrestrial Mammals That Occur in the Vicinity of Keesler Air Force Base, Biloxi, Mississippi

Scientific Name	Common Name
MARSUPIALA	
Didelphis marsupialis	Opossum
EDENTATA	
Dasypus novemcinctus	Nine-banded armadillo
LAGOMORPHA	
Sylvilagus aquaticus littoralis	Swamp rabbit
RODENTIA	
Mus musculus	House mouse
Ondatra zibethicus rivalicus	Louisiana muskrat
Oryzomys palustris palustris	Rice rat
Rattus norvegicus	Norway rat
Rattus rattus	Black rat
Sciurus carolinensis	Gray squirrel
Sigmodon hispidus hispidus	Hispid cotton rat
CARNIVORA	
Lutra canadensis	River otter
Mustela vison	Mink
Myocaster coypus bonariensis	Nutria
Procyon lotor various	Raccoon

Sources: Burt et al. 1976; COE 1984b.

Table 3.2.2.1.2-1. Birds That Occur in Coastal Mississippi
(Page 1 of 8)

Scientific Name	Common Name
GAVIIFORMES	
Gavia immer	Common loon
PODICIPEDIFORMES	
Podiceps auritus	Horned grebe
Podiceps nigricollis	Eared grebe
Podilymbus podiceps	Pied-billed grebe
PELACANIFORMES	
Anhinga anhinga	Anhinga
Fregata magnificens	Magnificent frigatebird
Pelecanus erythrorhynchos	American white pelican
Pelecanus occidentalis	Brown pelican
Phalacrocorax auritus	Double-crested cormorant
Sula bassanus	Northern gannet
CICONIIFORMES	
Ardea herodias	Great blue heron
Botaurus lentiginosus	American bittern
Bubulcus ibis	Cattle egret
Butorides striatus	Green-backed heron
Casmerodius albus	Great egret
Dichromanassa rufescens	Reddish egret
Egretta caerulea	Little blue heron
Egretta rufescens	Reddish egret
Egretta thula	Snowy egret
Egretta tricolor	Tricolored heron
Eudocimus albus	White ibis
Ixobrychus exilis	Least bittern
Nycticorax nycticorax	Black-crowned night heron
Nycticorax violaceus	Yellow-crowned night heron
Plegadis falcinellas	Glossy ibis
ANSERIFORMES	
Aix sponsa	Wood duck
Anas acuta	Northern pintail
Anas americana	American wigeon

Table 3.2.2.1.2-1. Birds That Occur in Coastal Mississippi
(Page 2 of 8)

Scientific Name	Common Name
Anas clypeata	Northern shoveler
Anas crecca	Green-winged teal
Anas discors	Blue-winged teal
Anas fulvigula	Mottled duck
Anas platyrhynchos	Mallard
Anas rubripes	Black duck
Anas strepera	Gadwall
Anser albifrons	White-fronted goose
Aythya affinis	Lesser scaup
Aythya americana	Redhead
Aythya collaris	Ring-necked duck
Aythya marila	Greater scaup
Aythya valisneria	Canvasback
Branta canadensis	Canada goose
Bucephala albeola	Bufflehead
Bucephala clangula	Common goldeneye
Chen caerulescens	Snow goose
Clangula hyemalis	Oldsquaw
Lophodytes cucullatus	Hooded merganser
Melanitta perspicillata	Surf scoter
Mergus serrator	Red-breasted merganser
Oxyura jamaicensis	Ruddy duck
FALCONIFORMES	
Accipiter couperii	Cooper's hawk
Accipiter striatus	Sharp-shinned hawk
Aquila chrysaetos	Golden eagle
Buteo jamaicensis	Red-tailed hawk
Buteo lineatus	Red-shouldered hawk
Buteo platypterus	Broad-winged hawk
Cathartes aura	Turkey vulture
Circus cyaneus	Northern harrier
Coragyps atratus	Black vulture
Elanoides forficatus	American swallow-tailed kite
Falco columbarius	Merlin
Falco peregrinus	Peregrine falcon
Falco sparverius	American kestrel
Haliaeetus leucocephalus	Bald eagle
Ictinia mississippiensis	Mississippi kite
Pandion haliaetus	Osprey

Table 3.2.2.1.2-1. Birds That Occur in Coastal Mississippi
(Page 3 of 8)

Scientific Name	Common Name
GALLIFORMES	
Colinus virginianus	Northern bobwhite
Meleagris gallopavo	Wild turkey
GRUIFORMES	
Fulica americana	American coot
Gallinula chloropus	Common moorhen
Grus canadensis	Sandhill crane
Porphyrula martinica	Purple gallinule
Porzana carolina	Sora rail
Rallus elegans	King rail
Rallus limicola	Virginia rail
Rallus longirostris	Clapper rail
CHARADRIIFORMES	
Actitis macularia	Spotted sandpiper
Anous stolidus	Brown noddy
Arenaria interpres	Ruddy turnstone
Bartramia longicauda	Upland sandpiper
Calidris alba	Sanderling
Calidris alpina	Dunlin
Calidris canutus	Red knot
Calidris fuscicollis	White-rumped sandpiper
Calidris maritima	Purple sandpiper
Calidris mauri	Western sandpiper
Calidris melanotos	Pectoral sandpiper
Calidris minutilla	Least sandpiper
Calidris pusilla	Semipalmated sandpiper
Catoptrophorus semipalmatus	Willet
Charadrius alexandrinus	Snowy plover
Charadrius melodus	Piping plover
Charadrius semipalmatus	Semipalmated plover
Charadrius vociferus	Killdeer
Charadrius wilsonia	Wilson's plover
Chlidonias niger	Black tern
Gallinago gallinago	Common snipe
Haematopus palliatus	American oystercatcher
Himantopus mexicanus	Black-necked stilt
Larus argentatus	Herring gull

Table 3.2.2.1.2-1. Birds That Occur in Coastal Mississippi
(Page 4 of 8)

Scientific Name	Common Name
Larus atricilla	Laughing gull
Larus delawarensis	Ring-billed gull
Larus philadelphia	Bonaparte's gull
Larus pipixcan	Franklin's gull
Limnodromus griseus	Short-billed dowitcher
Limnodromus scolopaceus	Long-billed dowitcher
Limosa fedoa	Marbled godwit
Micropalama himantopus	Stilt sandpiper
Numenius americanus	Long-billed curlew
Numenius borealis	Whimbrel
Philohela minor	American woodcock
Pluvialis dominica	Lesser golden plover
Pluvialis squatarola	Black-bellied plover
Recurvirostra americana	American avocet
Rynchops niger	Black skimmer
Steganopus tricolor	Wilson's phalarope
Sterna antillarum	Least tern
Sterna caspia	Caspian tern
Sterna dougalii	Roseate tern
Sterna forsteri	Forster's tern
Sterna fuscata	Sooty tern
Sterna hirundo	Common tern
Sterna maxima	Royal tern
Sterna nilotica	Gull-billed tern
Sterna sandvicensis	Sandwich tern
Tringa flavipes	Lesser yellowlegs
Tringa melanoleuca	Greater yellowlegs
Tringa solitaria	Solitary sandpiper
Tryngites subruficollis	Buff-breasted sandpiper
COLUMBIFORMES	
Columba livia	Rock dove
Zenaida macroura	Mourning dove
CUCULIFORMES	
Coccyzus americanus	Yellow-billed cuckoo
Coccyzus erythropthalmus	Black-billed cuckoo

Table 3.2.2.1.2-1. Birds That Occur in Coastal Mississippi
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Scientific Name	Common Name
STRIGIFORMES	
Athene cunicularia	Burrowing owl
Bubo virginianus	Great horned owl
Otus asio	Eastern screech owl
Strix varia	Barred owl
Tyto alba	Common barn owl
CAPRIMULGIFORMES	
Caprimulgus carolinensis	Chuck-will's-widow
Caprimulgus vociferus	Whip-poor-will
Chordeiles minor	Common nighthawk
APODIFORMES	
Archilochus colubris	Ruby-throated hummingbird
Chaetura pelagica	Chimney swift
CORACIIFORMES	
Ceryle alcyon	Belted kingfisher
PICIFORMES	
Colaptes auratus	Northern flicker
Dryocopus pileatus	Pileated woodpecker
Melanerpes carolinus	Red-bellied woodpecker
Melanerpes erythrocephalus	Red-headed woodpecker
Picoides borealis	Red-cockaded woodpecker
Picoides pubescens	Downy woodpecker
Picoides villosus	Hairy woodpecker
Sphyrapicus varius	Yellow-bellied sapsucker
PASSERIFORMES	
Agelaius phoeniceus	Red-winged blackbird
Aimophila aestivalis	Bachman's sparrow
Ammospiza caudacuta	Sharp-tailed sparrow
Ammospiza maritima	Seaside sparrow
Anthus spinoletta	Water pipit
Bombycilla cedrorum	Cedar waxwing

Table 3.2.2.1.2-1. Birds That Occur in Coastal Mississippi
(Page 6 of 8)

Scientific Name	Common Name
Cardinalis cardinalis	Northern cardinal
Carduelis pinus	Pine siskin
Carduelis tristis	American gold finch
Carpodacus purpureus	Purple finch
Catharus fuscescens	Veery
Catharus guttatus	Hermit thrush
Catharus minimus	Gray-cheeked thrush
Catharus ustulatus	Swainson's thrush
Certhia familiaris	Brown creeper
Cistothorus palustris	Marsh wren
Cistothorus platensis	Sedge wren
Contopus virens	Eastern wood pewee
Corvus brachyrhynchos	American crow
Corvus ossifragus	Fish crow
Cyanocitta cristata	Blue jay
Dendroica caerulescens	Black-throated blue warbler
Dendroica castanea	Bay-breasted warbler
Dendroica cerulea	Cerulean warbler
Dendroica coronata	Yellow-rumped warbler
Dendroica discolor	Prairie warbler
Dendroica dominica	Yellow-throated warbler
Dendroica fusca	Blackburnian warbler
Dendroica magnolia	Magnolia warbler
Dendroica palmarum	Palm warbler
Dendroica pensylvanica	Chestnut-sided warbler
Dendroica petechia	Yellow warbler
Dendroica pinus	Pine warbler
Dendroica striata	Blackpoll warbler
Dendroica tigrina	Cape May warbler
Dendroica virens	Black-throated green warbler
Dolichonyx oryzivorus	Bobolink
Dumetella carolinensis	Gray catbird
Empidonax minimus	Least flycatcher
Empidonax virescens	Acadian flycatcher
Euphagus carolinus	Rusty blackbird
Euphagus cyanocephalus	Brewer's blackbird
Geothlypis trichas	Common yellowthroat
Guiraca caerulea	Blue grosbeak
Helmitheros vermivorus	Worm-eating warbler
Hirundo rustica	Barn swallow
Hylocichla mustelina	Wood thrush

Table 3.2.2.1.2-1. Birds That Occur in Coastal Mississippi
(Page 7 of 8)

Scientific Name	Common Name
Icterus galbula	Northern oriole
Icterus spurius	Orchard oriole
Icteria virens	Yellow-breasted chat
Juncus hyemalis	Dark-eyed junco
Lanius ludovicianus	Loggerhead shrike
Limnothlypis swainsonii	Swainson's warbler
Melospiza georgiana	Swamp sparrow
Melospiza melodia	Song sparrow
Mimus polyglottos	Northern mockingbird
Molothrus ater	Brown-headed cowbird
Mniotilta varia	Black and white warbler
Myiarchus crinitus	Great-crested flycatcher
Oporornis formosus	Kentucky warbler
Oporornis philadelphia	Mourning warbler
Parula americana	Northern parula
Parus bicolor	Tufted titmouse
Parus carolinensis	Carolina chickadee
Passer domesticus	House sparrow
Passerculus sandwichensis	Savannah sparrow
Passerina ciris	Painted bunting
Passerina cyanea	Indigo bunting
Petrocheiidon pyrrhonata	Cliff swallow
Pheucticus ludovicianus	Rose-breasted grosbeak
Pipilo erythrophthalmus	Rufous-sided towhee
Piranga olivacea	Scarlet tanager
Piranga rubra	Summer tanager
Polioptila caerulea	Blue-gray gnatcatcher
Pooecetes gramineus	Vesper sparrow
Progne subis	Purple martin
Protonotaria citrea	Prothonotary warbler
Quiscalus major	Boat-tailed grackle
Quiscalus quiscula	Common grackle
Regulus calendula	Ruby-crowned kinglet
Regulus satrapa	Golden-crowned kinglet
Riparia riparia	Bank swallow
Sayornis phoebe	Eastern phoebe
Seiurus aurocapillus	Ovenbird
Seiurus motacilla	Louisiana waterthrush
Seiurus noveboracensis	Northern waterthrush
Setophaga ruticilla	American redstart
Sialia sialis	Eastern bluebird

Table 3.2.2.1.2-1. Birds That Occur in Coastal Mississippi
(Page 8 of 8)

Scientific Name	Common Name
Sitta canadensis	Red-breasted nuthatch
Sitta pusilla	Brown-headed nuthatch
Spizella passerina	Chipping sparrow
Spizella pusilla	Field sparrow
Stelgidopterx serripennis	Northern rough-winged swallow
Sturnella magna	Eastern meadowlark
Sturnus vulgaris	European starling
Tachycineta bicolor	Tree swallow
Thryothorus ludovicianus	Carolina wren
Toxostoma rufum	Brown thrasher
Troglodytes aedon	House wren
Troglodytes troglodytes	Winter wren
Turdus migratorius	American robin
Tyrannus dominicensis	Gray kingbird
Tyrannus tyrannus	Eastern kingbird
Tyrannus verticalis	Western kingbird
Vermivora celata	Orange-crowned warbler
Vermivora chrysoptera	Golden-winged warbler
Vermivora peregrina	Tennessee warbler
Vermivora pinus	Blue-winged warbler
Vermivora ruficapilla	Nashville warbler
Vireo flavifrons	Yellow-throated vireo
Vireo gilvus	Warbling vireo
Vireo griseus	White-eyed vireo
Vireo olivaceus	Red-eyed vireo
Vireo philadelphicus	Philadelphia vireo
Vireo solitarius	Solitary vireo
Wilsonia canadensis	Canada warbler
Wilsonia citrina	Hooded warbler
Wilsonia pusilla	Wilson's warbler
Zonotrichia albicollis	White-throated sparrow
Zonotrichia leucophrys	White-crowned sparrow

Source: Toups and Jackson 1987.

grackle (*Quiscalus major*), Fish crow (*Corvus ossifragus*), Gray kingbird (*Tyrannus dominicensis*), Marsh wren (*Cistothorus palustris*), and the Seaside sparrow (*Ammodramus maritimus*) (USACOE 1984b).

Common wading birds include the Tricolored heron (*Egretta tricolor*), Little blue heron (*Egretta caerulea*), Great blue heron (*Ardea herodias*), Green-backed heron (*Butorides striatus*), and the Snowy egret (*Egretta thula*). Shore birds use unvegetated sandy shores that are semi-isolated from human use. The Royal tern (*Sterna maxima*), Common tern (*Sterna hirundo*), Least tern (*Sterna antillarum*), Caspian tern (*Sterna caspia*), Forster's tern (*Sterna forsteri*), and the Laughing gull (*Larus atricilla*) are some of the most common shore birds found along Mississippi's coast. During a site visit in July 1989, the Least tern and the Black skimmer (*Rynchops niger*) were observed nesting on beaches next to the Gulfport city pier and other protected beach areas in Harrison County.

Some species that commonly occur in urbanized areas such as Keesler AFB include the Northern mockingbird (*Mimus polyglottos*), House sparrow (*Passer domesticus*), Brown thrasher (*Toxostoma rufum*), Cardinal (*Cardinalis cardinalis*), Blue jay (*Cyanocitta cristata*), and Mourning dove (*Zenaida macroura*). Mature live oaks at Keesler AFB were sited by Toups and Jackson (1987) as significant coastal bird habitat. The greatest variety of species is present August through May. Clapper rails (*Rallus longirostris*) probably utilize the deltas in Back Bay located just offshore of the base (Heard 1989; Toups 1989).

3.2.2.1.3 Reptiles and Amphibians—Table 3.2.2.1.3-1 exhibits a list of amphibians and reptiles that are likely to occur in coastal Mississippi. Eighteen species of salamander and 22 species of frogs and toads occur in coastal Alabama and Mississippi (Mount 1975). The number of amphibian species is somewhat restricted in coastal environs because most require the presence of permanent or semi-permanent fresh water for

Table 3.2.2.1.3-1. Reptiles and Amphibians of Coastal Mississippi Possibly Found on the Proposed Keesler Site (Page 1 of 3)

Scientific Name	Common Name
CAUDATA	
Ambystoma maculatum	Spotted salamander
Ambystoma opacum	Marbled salamander
Ambystoma talpoideum	Mole salamander
Ambystoma texanum	Small-mouthed salamander
Eurycea bislineata	Northern two-lined salamander
Eurycea longicauda guttolineata	Three-lined salamander
Notophthalmus viridescens louisianensis	Central newt
Plethodon glutinosus	Slimy salamander
Pseudotriton montanus flavissimus	Gulf Coast mud salamander
ANURA	
Acris crepitans	Northern cricket frog
Acris gryllus	Southern cricket frog
Bufo quercicus	Oak toad
Bufo terrestris	Southern toad
Bufo woodhousei fowleri	Fowler's toad
Gastrophryne carolinensis	Eastern narrow-mouthed toad
Hyla avivoca	Western bird-voiced tree frog
Hyla chrysoscelis	Gray treefrog
Hyla cinerea	Green treefrog
Hyla crucifer	Northern spring peeper
Hyla femoralis	Pine woods treefrog
Hyla gratiosa	Barking treefrog
Hyla squirrela	Squirrel treefrog
Hyla versicolor	Gray treefrog
Pseudacris ornata	Ornate chorus frog
Rana catesbeiana	Bull frog
Rana clamitans	Bronze frog
Rana grylio	Pig frog
Rana heckscheri	River frog
Rana sphenocephala	Southern leopard frog
Scaphiophus holbrooki	Eastern spadefoot toad
SQUAMATA	
Agkistrodon contortrix contortrix	Southern copperhead
Anolis carolinensis	Green anole
Agkistrodon piscivorus	Eastern cottonmouth

Table 3.2.2.1.3-1. Reptiles and Amphibians of Coastal Mississippi Possibly Found on the Proposed Keesler Site (Page 2 of 3)

Scientific Name	Common Name
Carphophis amoenus helenae	Midwest worm snake
Cemophora coccinea copei	Northern scarlet snake
Cnemidophorus sexlineatus	Six-lined racerunner
Coluber constrictor priapus	Southern black racer
Crotalus adamanteus	Eastern diamondback rattlesnake
Crotalus horridus atricaudatus	Canebrake rattlesnake
Diadophis punctatus stictogenys	Mississippi ringneck snake
Elaphe guttata	Corn snake
Elaphe obsoleta spiloides	Gray rat snake
Eumeces fasciatus	Five-lined skink
Eumeces laticeps	Broad-headed skink
Farancia abacura reinwardti	Western mud snake
Heterodon platyrhinos	Eastern hognose snake
Lampropeltis calligaster rhombomaculata	Mole snake
Lampropeitis getulus holbrooki	Speckled kingsnake
Lampropeitis triangulum elapsoides	Scarlet kingsnake
Masticophis flagellum	Eastern coachwhip
Nerodia cyclopion cyclopion	Green water snake
Nerodia erythrogaster flavigaster	Yellow-bellied water snake
Nerodia fasciata clarki	Gulf salt marsh water snake
Nerodia rhombifera	Diamondback water snake
Nerodia sipedon pleuralis	Midland water snake
Opheodrys aestivus	Rough green snake
Ophisaurus attenuatus longicaudis	Eastern slender glass lizard
Rhadinaea flavilata	Pine woods snake
Sceloporus undulatus	Southern fence lizard
Scincella lateralis	Ground skink
Sistrurus miliarus barbouri	Dusky pygmy rattlesnake
Storeria dekayi wrightorum	Midland brown snake
Storeria occipitomaculata	Northern red-bellied snake
Tantilla coronata	Southeastern crowned snake
Thamnophis sauritus	Eastern ribbon snake
Thamnophis sirtalis	Eastern garter snake
Virginia striatula	Rough earth snake
Virginia valeriae	Smooth earth snake
TESTUDINES	
Chelydra serpentina serpentina	Common snapping turtle
Chrysemys concinna mobilensis	Mobile cooter
Chrysemys floridana hoyi	Missouri slider
Chrysemys scripta scripta	Yellow-bellied slider

Table 3.2.2.1.3-1. Reptiles and Amphibians of Coastal Mississippi Possibly Found on the Proposed Keesler Site (Page 3 of 3)

Scientific Name	Common Name
Kinosternon subrubrum hippocrepis	Mississippi mud turtle
Macroclemys temmincki	Alligator snapping turtle
Malaclemys terrapin pileata	Mississippi diamondback terrapin
Sternotherus odoratus	Stinkpot
Terrapene carolina triunguis	Three-toed box turtle
Trionyx muticus calvatus	Gulf Coast smooth softshell
Trionyx spiniferus asperus	Gulf Coast spiny softshell
CROCODILIA	
Alligator mississippiensis	American alligator

Sources: Conant 1975; Lohoefener and Altig 1983.

their survival and reproduction. However, members of Bufo spp. and Hyla spp. possess a dry, cornified skin that prevents excessive loss of body water and allows them to live in relatively dry environments (O'Neil and Mettee 1982).

Mount (1975) lists 23 species of turtles, 10 species of lizards, 39 snakes, and the American alligator (Alligator mississippiensis) as occurring in coastal Alabama and Mississippi. Excluding the sea turtles, only two reptiles, the Mississippi diamondback terrapin (Malaclemys terrapin pileata) and the Gulf saltmarsh water snake (Nerodia fasciata clarki) normally occur in brackish waters of estuarine tidal marshes (USACOE 1984b; Lohoefener and Altig 1983). The American alligator and the Florida cooter (Pseudemys floridana) have been known to enter brackish water on occasion. The 10 species of lizards found in coastal Alabama and Mississippi inhabit terrestrial environments (USACOE 1984b).

3.2.2.1.4 **Commercial Species**—Species that are hunted or trapped in the project area include raccoon, opossum, beaver, muskrat, nutria, and waterfowl. These species are considered a food resource and/or their furs are of some commercial value.

3.2.2.1.5 **Threatened and Endangered Species**—Under the authority of the Mississippi Department of Natural Resources, the MNHP has listed threatened and endangered animals which are protected under MS Statute 49-5-109. The MNHP stated in a letter received July 10, 1989 that there were no records of threatened or endangered species or critical habitat on Keesler AFB.

Although there are no known threatened or endangered species present on Keesler AFB, the base is within the range of a number of mammal, bird, and reptile species protected by state and federal legislation. Federally listed species are protected under the Department of the

Table 3.2.2.1.5-1. Threatened and Endangered Terrestrial Animals Observed or of Possible Occurrence in the Vicinity of Keesler Air Force Base, Biloxi, Mississippi

Scientific Name	Common Name	Status Mississippi	Status Federal	Habitat
REPTILES				
Alligator mississippiensis	American alligator	E	E	Marshes
BIRDS				
Charadrius alexandrinus	Snowy Plover	E	C2	Sand flats, beaches
Falco peregrinus	Peregrine Falcon	E	E	Beach
Haliaeetus leucocephalus	Bald Eagle	E	E	Open bay, marshes
Pelecanus occidentalis	Brown Pelican	E	E	Open bay
Sterna antillarum	Least Tern	-	E	Beach, open bay

T=Threatened
E=Endangered
C2=Under review for listing, but substantial evidence of biological vulnerability and/or threat is lacking.

Source: Mississippi Department of Wildlife Conservation 1989.

Interior. Table 3.2.2.1.5-1 lists the status of state and federally protected animal species which may occur on or near Keesler AFB. Species listed were selected on the basis of species range and presence of suitable habitat.

The American alligator (Alligator mississippiensis) is known to occur in Back Bay of Biloxi and may utilize the salt marsh at the northern edge of Keesler AFB for resting and foraging (Hase 1989). Since the salt marsh is adjacent to an urban environment, it is doubtful that the alligator nests there.

The Southern bald eagle (Haliaeetus leucocephalus) forages along the Biloxi River and presumably Back Bay of Biloxi. The closest known nest lies approximately 7 miles north of the project site on the Biloxi River upstream of Interstate 10 (Buchannon 1989). It is doubtful the eagle ever occurs on Keesler AFB, since it generally avoids urban areas.

The Peregrine falcon (Falco peregrinus) is not known to breed in Mississippi, although it occasionally winters on the barrier islands. This species may forage along mainland beaches and estuaries, where it preys upon shorebirds.

Brown pelican (Pelecanus occidentalis) populations are increasing in Mississippi, but this species is not known to breed in the state. They can be seen feeding on fish along the beaches and barrier islands.

Least terns (Sterna antillarum) and Black skimmers (Rynchops niger) nest along coastal Mississippi in June and July. Least terns have successfully nested on a supply building roof at the base (Hase 1989).

The Wood stork (Mycteria americana) may forage in wetland habitats associated with Back Bay, although this species generally prefers freshwater marshes. According to Toups and Jackson (1987), breeding in Mississippi is unknown. This species is considered to be a summer visitor.

The Snowy plover (Charadrius alexandrius) nests primarily on the barrier islands but, occasionally, nesting occurs on mainland beaches. This species utilizes food resources along the beaches just south of the project site and possibly in Back Bay.

The Piping plover (Charadrius melodus) is a winter resident and does not breed in Mississippi. It is likely to forage along the barrier islands and mainland beaches.

3.2.2.1.6 Unique and Critical Habitats—The salt marsh on the northern edge of Keesler AFB is considered critical habitat because, as a portion of the Back Bay estuary, it represents significant wildlife habitat. Wetlands associated with Back Bay of Biloxi are sensitive to perturbation because they have been reduced in size and fragmented by dredge and fill projects, and they receive significant urban stormwater runoff. The salt marsh at Keesler AFB has already been partially filled. Mud flats and marsh areas north of the channel were listed as preservation areas by the MNHP (Gordon 1989).

The large, mature oak trees on the base provide foraging, resting, and nesting habitat for a large number of arboreal wildlife species. Because oaks exhibit very slow growth rates, mature oaks practically represent an irreplaceable habitat resource.

3.2.2.2 Freshwater Fauna

Very little freshwater habitat occurs in the vicinity of Keesler AFB and none exists at the proposed location of the Weather Training Facility or on the proposed site of the NEXRAD radar installation. Therefore, freshwater fauna on Keesler AFB is very limited. Some freshwater fish and aquatic invertebrates tolerate low salinity levels. These species may occasionally occur in Back Bay of Biloxi wherever oligohaline waters are prevalent.

3.2.2.3 Marine Fauna

Keesler AFB is located inland of Mississippi Sound although it is bounded on the north by the Back Bay of Biloxi. None of the base property would be considered "marine." Therefore, the marine fauna will be discussed only in regards to species found offshore of Keesler AFB to permit determinations of secondary impacts from the influx of personnel into the Biloxi area. The marine fauna offshore of Keesler AFB includes mammals, reptiles, finfish, shellfish, and benthic invertebrates. This section will discuss the seasonal distribution, migrational patterns, commercial species, protected species, and unique and critical habitats for the marine fauna.

3.2.2.3.1 **Mammals**—Marine mammals known to occur in the northern Gulf of Mexico are listed in Table 3.2.2.3.1-1. Life histories and distribution of marine mammals were reviewed by Schmidley (1981). Unpublished marine mammal stranding data for Mississippi were provided by Dr. Daniel Odell (1989). Table 3.2.2.3.1-2 provides a summary of reported strandings for *Tursiops truncatus* (Atlantic bottlenose dolphins) and *Kogia breviceps* (pygmy sperm whales) along the coast of Mississippi.

3.2.2.3.2 **Reptiles**—Five species of sea turtles known to occur in Mississippi Sound include the loggerhead turtle (*Caretta caretta*), green turtle (*Chelonia mydas*), leatherback turtle (*Dermochelys coriacea*), hawksbill turtle (*Eretmochelys imbricata*), and the Atlantic ridley turtle (*Lepidochelys kempi*). General information concerning distribution, status, and life histories of sea turtles is provided by Fuller (1978), Ogren (1978), CCC (1980), and Carr, et al. (1982).

Marine sea turtles generally prefer more saline waters of the Gulf of Mexico, although they enter estuaries occasionally. The barrier islands of the northern Gulf coast have been used as nesting sites by green and loggerhead turtles. The Atlantic ridley rarely occurs in the northern Gulf of Mexico (Behler and King 1979).

Table 3.2.2.3.1-1. Marine Mammals Found in the Nearshore Waters of the Gulf of Mexico between New Orleans, Louisiana and Panama City, Florida

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Order Sirenia
- Family Trichechidae
  - *Trichechus manatus* - West Indian manatee

Order Cetacea
- Suborder Mysticeti - Baleen whales
  - Family Balaenopteridae - Rorquals
    - *Balaenoptera borealis* - Sei whale
    - *Balaenoptera physalus* - Fin whale
- Suborder Odontoceti - Toothed whales
  - Family Physeteridae - Sperm whales
    - *Kogia breviceps* - Pygmy sperm whale
    - *Kogia simus* - Dwarf sperm whale
  - Family Ziphiidae - Beaked whales
    - *Mesoplodon europaeus* - Antillean beaked whale
    - *Ziphius cavirostris* - Goosebeaked whale
  - Family Delphinidae - Delphinids
    - *Pseudorca crassidens* - False killer whale
    - *Orcinus orca* - Killer whale
    - *Globicephala macrorhynchus* - Short-finned pilot whale
    - *Tursiops truncatus* - Atlantic bottlenose dolphin
    - *Stenella plagiodon* - Atlantic spotted dolphin
    - *Stenella longirostris* - Spinner dolphin

Sources: Schmidley 1981.
Stevenson 1976.

Table 3.2.2.3.1-2. Marine Mammal Strandings for Coastal Mississippi, 1984-1989

Year	*Tursiops truncatus*	*Kogia breviceps*
1984	3	2
1985	16	1
1986	24	--
1987	19	--
1988	41	--
1989	5	--

Source: Odell 1989.

The distribution of reported sea turtle strandings provides some indication of species frequency of occurrence in the region. True strandings are defined as individuals that are washed ashore. These turtles may be dead, or alive, but in a weakened condition. Also included are individuals that are found floating (dead or in a weakened condition) in nearshore or bay areas. Stranding data are summarized in Table 3.2.2.3.2-1.

3.2.2.3.3 Finfish--The bays and barrier islands on the periphery of Mississippi Sound play an important role in the creation of a diversity of habitats supporting a large number of fish and shellfish species. The barrier islands provide physical protection and help separate low salinity waters from marine waters, thus allowing the development of estuarine habitat ideal for fish nurseries (Fore and Peterson 1980). Vittor and Associates, Inc. (1985) provide a good review of Mississippi coastal fish surveys including data from the National Marine Fisheries Service (NMFS) ground fish surveys. Fish nurseries, marine grassbeds, and oyster reefs of the Mississippi coast have been mapped by Garofalo (1981). A list of Mississippi Sound fish species compiled by Christmas and Waller (1973) is presented in Table 3.2.2.3.3-1. Although the life histories of Mississippi Sound fish species vary, a general pattern of offshore spawning in fall and winter, followed by migration to nursery grounds in spring, is common.

Extensive studies were conducted by Christmas and Waller (1973) concerning occurrence, relative abundance, seasonal and area distribution, as well as other aspects of Mississippi estuarine fishes. Bay anchovy (*Anchoa mitchilli*), Gulf menhaden (*Brevoortia patronus*), Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*), butterfish (*Peprilus triacanthus*), and sand seatrout (*Cynoscion arenarius*) represented 93 percent of the total collection.

Table 3.2.2.3.2-1. Turtle Stranding Data by Species and Month for the Period 1986-1989 for Mississippi

Month	*Caretta caretta*	*Lepidochelys kempi*	*Chelonia mydas*	*Dermochelys coriacea*	*Eretmochelys imbricata*	Unidentified
1		1				
2	1					
3	1					
4	2	1	3			
5	6					
6	8	1	1	1		2
7		1				
8		1				
9	1	2			1	1
10	2	2				
11	3	5	1			
12		2				
Total	24	16	5	1	1	3

Source: National Marine Fisheries Service 1989.

Table 3.2.2.3.3-1. Fish Species of the Mississippi Sound (Page 1 of 7)

Scientific Name	Common Name	Estuarine*	Marine Entering Estuary†
Ablennes hians	Flat needlefish		U
Abudefduf saxatilis	Sargeant major		R
Achirus lineatus	Lined sole		A
Acipenser oxyrhynchus desotoi	Atlantic sturgeon	R	
Adinia xenica	Diamond killfish	A	
Aetobatus narinari	Spotted eagle ray		R
Ahlia egmontis	Key worm eel		R
Alectis ciliaris	African pompano		R
Alosa chrysochloris	Skipjack herring		A
Aluterus schoepfi	Orange filefish		U
Amia calva	Bowfin	U	
Anchoa hepsetus**	Striped anchovy		A
Anchoa lyolepis	Dusky anchovy		U
Anchoa mitchilli	Bay anchovy	A	
Ancylopsetta quadrocellata	Ocellated flounder		C
Anguilla rostrata	American eel	C	
Antennarious radiosus	Singlespot frogfish		U
Archosargus probatocephalus**	Sheepshead		A
Arius felis**	Hardhead catfish		A
Astroscopus y-graecum**	Southern stargazer		C
Bagre marinus**	Gafftopsail catfish		A
Bairdiella chrysoura**	Silver perch		A
Bascanichthys bascanium	Sooty eel		C
Bascanichthys scuticaris	Whip eel		U
Bathygobius soporator	Frillfin goby		U
Brevoortia patronus**	Gulf menhaden		A
Brevoortia smithi	Yellowfin menhaden		R
Caranx bartholomaei	Yellow jack		R
Caranx crysos	Blue runner		C
Caranx hippos	Crevalle jack		C
Caranx latus**	Horse-eye jack		U
Carcharhinus acronotus	Blacknose shark		R
Carcharhinus isodon	Finetooth shark		R
Carcharhinus leucas	Bull shark		C
Carcharhinus limbatus	Blacktip shark		C
Carpiodes carpio	River carpsucker	C	
Carpiodes cyprinus	Quillback	C	
Centropristis philadelphica	Rock sea bass		C
Chaetodipterus faber	Atlantic spadefish		A

Table 3.2.2.3.3-1. Fish Species of the Mississippi Sound (Page 2 of 7)

Scientific Name	Common Name	Estuarine*	Marine Entering Estuary†
Chaetodon capistratus	Foureye butterflyfish		R
Chaetodon ocellatus	Spotfin butterflyfish		R
Chaetodon sedentarius	Reef butterflyfish		R
Chasmodes bosquianus	Striped blenny	C	
Chasmodes saburrae**	Florida blenny		U
Chilomycterus schoepfi**	Striped burrfish		C
Chloroscombrus chrysurus	Atlantic bumper		C
Citharichthys macrops	Spotted whiff		U
Citharichthys spilopterus**	Bay whiff		A
Cynoscion arenarius	Sand seatrout		A
Cynoscion nebulosus**	Spotted seatrout	A	
Cynoscion nothus	Silver seatrout		U
Cyprinodon variegatus**	Sheepshead minnow	A	
Cypselurus melanurus	Atlantic flyingfish		R
Dactyloscopus tridigitatus**	Sand stargazer		R
Dasyatis americana	Southern stingray		U
Dasyatis sabina**	Atlantic stingray		A
Dasyatis sayi**	Bluntnose stingray		C
Decapterus punctatus	Round scad		R
Diplectrum bivittatum	Dwarf sand perch		R
Dormitator maculatus	Fat sleeper		C
Dorosoma cepedianum	Gizzard shad		U
Dorosoma petenense	Threadfin shad		A
Echeneis naucrates	Sharksucker		R
Eleotris pisonis	Spinycheek sleeper		C
Elops saurus	Ladyfish		A
Epinephelus drummondhayi	Speckled hind		U
Epinephelus nigritus	Warsaw grouper		U
Equetus acuminatus	High-hat		R
Erimyzon tenuis	Sharpfin chubsucker	C	
Erotelis smaragdus	Emerald sleeper		U
Esox niger	Chain pickerel	C	
Etropus crossotus	Fringed flounder		A
Etropus microstomus	Smallmouth flounder		R
Eucinostomus argenteus**	Spotfin mojarra		C
Eucinostomus gula**	Silver jenny		U
Evorthodus lyricus	Lyre goby		C
Fistularia tabacaria	Bluespotted cornetfish		R
Fundulus chrysotus	Golden topminnow		R
Fundulus confluentus	Marsh killifish		R

Table 3.2.2.3.3-1. Fish Species of the Mississippi Sound (Page 3 of 7)

Scientific Name	Common Name	Estuarine*	Marine Entering Estuary†
*Fundulus grandis***	Gulf killifish	A	
Fundulus jenkinsi	Saltmarsh topminnow	A	
*Fundulus notti***	Southern starheaded topminnow	??	??
Fundulus olivacens	Blackspotten topminnow	C	
Fundulus pulvereus	Bayou killifish	U	
*Fundulus similis***	Longnose killifish	A	
Galeocerdo cuvieri	Tiger shark		R
*Gambusia affinis***	Mosquitofish	A	
Gobiesox strumosus	Skilletfish		C
Gobioides broussoneti	Violet goby		U
Gobionellus boleosoma	Darter goby	A	
Gobionellus hastatus	Sharptail goby	A	
Gobionellus shufeldti	Freshwater goby	C	
Gobionellus stigmaturus	Spottail goby	U	
Gobiosoma bosci	Naked goby	A	
Gobiosoma longipala	Twoscale goby	U	
Gobiosoma robustum	Code goby	C	
Gunterichthys longipenis	Gold brotula	U	
Gymnachirus texae	Fringed sole		R
Gymnothorax nigromarginatus	Blackedge moray		U
Gymnura micrura	Smooth butterfly ray		R
*Harengula jaguana***	Scaled sardine		A
Hemicaranx amblyrhynchus	Bluntnose jack		R
Hemipteronotus novacula	Pearly razorfish		R
Heterandria formosa	Least killifish	C	
Hildebrandia flava	Yellow conger		R
*Hippocampus erectus***	Lined seahorse		C
Hippocampus zosterae	Dwarf seahorse		U
Histrio histrio	Sargassumfish		R
Hybognathus hayi	Cypress minnow	U	
Hybopsis aestivalis	Speckled chub	C	
Hybopsis amblops	Bigeye club	C	
Hypleurochilus geminatus	Crested blenny		R
*Hyporhamphus unifasciatus***	Halfbeak		C
Hypsoblennius hentzi	Feather blenny	C	
Hypsoblennius ionthus	Freckled blenny	C	

Table 3.2.2.3.3-1. *Fish Species of the Mississippi Sound* (Page 4 of 7)

Scientific Name	Common Name	Estuarine*	Marine Entering Estuary†
Ictalurus furcatus	Blue catfish	C	
Ictalurus natalis	Yellow bullhead	R	
Ictalurus nebulosus	Brown bullhead	R	
Ictalurus punctatus	Channel catfish	C	
Ictiobus bubalus	Smallmouth buffalo	U	
Kyphosus sectatrix	Bermuda chub		R
Labidesthes sicculus	Brook silverside	C	
Lactophrys quadricornis	Scrawled cowfish		C
Lagocephalus laevigatus	Smooth puffer		U
Lagodon rhomboides**	Pinfish		A
Larimus fasciatus**	Banded drum		C
Leiostomus xanthurus**	Spot		A
Lepisosteus oculatus	Spotted gar	C	
Lepisosteus osseus	Longnose gar	C	
Lepisosteus spatula**	Alligator gar	C	
Lepomis gulosus	Warmouth	C	
Lepomis macrochirus	Bluegill	A	
Lepomis megalotis	Longear sunfish	C	
Lepomis microlophus	Redear sunfish	C	
Lepomis punctatus	Spotted sunfish	C	
Lepophidium jeannae	Mottled cusk-eel		R
Lobotes surinamensis	Tripletail		U
Lucania parva**	Rainwater killifish	A	
Lutjanus griseus	Gray snapper		U
Lutjanus synagris	Lane snapper		U
Manta birostris	Atlantic manta		U
Megalops atlanticus	Tarpon		U
Membras martinica**	Rough silverside		A
Menidia beryllina**	Inland silverside	A	
Menidia menidia**	Atlantic silverside		
Menticirrhus americanus	Southern kingfish		C
Menticirrhus littoralis**	Gulf kingfish		C
Menticirrhus saxatilis**	Northern kingfish		U
Microdesmus longipinnis	Pink wormfish	U	
Micrognathus criniger	Fringed pipefish		R
Microgobius gulosus	Clown goby	U	
Microgobius thalassinus	Green goby	C	
Micropogonias undulatus**	Atlantic croaker		A
Micropterus punctulatus	Spotted bass		

Table 3.2.2.3.3-1. Fish Species of the Mississippi Sound (Page 5 of 7)

Scientific Name	Common Name	Estuarine*	Marine Entering Estuary†
Micropterus salmoides	Largemouth bass	C	
Monacanthus ciliatus	Fringed filefish		R
Monacanthus hispidus	Planehead filefish		C
Morone chrysops	White bass	R	
Morone mississippiensis**	Yellow bass	U	
Morone saxatilis	Striped bass		U
Mugil cephalus**	Striped mullet		A
Mugil curema**	White mullet		U
Mycteroperca bonaci	Black grouper		R
Myrophis punctatus**	Speckled worm eel	C	
Narcine brasiliensis	Lesser electric ray		A
Negaprion brevirostris	Lemon shark		R
Neomerinthe hemingwayi	Spinycheek scorpionfish		
Notropis petersoni	Coastal shiner	A	
Notropis venustus	Blacktail shiner	A	
Ogcocephalus nasutus	Shortnose batfish		R
Oligoplites saurus**	Leatherjacket		C
Ophichthus gomesi	Shrimp eel		A
Ophidion welshi	Crested cusk-eel		C
Opisthonema oglinum**	Atlantic thread herring		U
Opsanus beta	Gulf toadfish	C	
Opsanus tau**	Oyster toadfish		
Orthopristis chrysoptera	Pigfish		C
Paralichthys albigutta**	Gulf flounder		A
Paralichthys lethostigma**	Southern flounder		C
Peprilus alepidotus	Harvestfish		C
Peprilus burti	Gulf butterfish		A
Peprilus triacanthus**	Butterfish		
Poecilia latipinna**	Sailfin molly	A	
Pogonias cromis**	Black drum	C	
Polydactylus octonemus	Atlantic threadfin		U
Polyodon spathula	Paddlefish	R	
Pomacentrus fuscus	Dusky damselfish		R
Pomacentrus leucostictus	Beaugregory		R
Pomatomus saltatrix	Bluefish		C
Pomoxis annularis	White crappie	U	
Pomoxis nigromaculatus	Black crappie	C	
Porichthys plectrodon	Atlantic midshipman	C	
Prionotus evolans**	Striped searobin		R

Table 3.2.2.3.3-1. Fish Species of the Mississippi Sound (Page 6 of 7)

Scientific Name	Common Name	Estuarine*	Marine Entering Estuary†
Prionotus ophyras	Bandtail searobin		R
Prionotus roseus	Bluespotted searobin		C
Prionotus rubio	Blackfin searobin		U
Prionotus salmonicolor	Blackwing searobin		U
Prionotus scitulus	Leopard searobin		C
Prionotus tribulus	Bighead searobin		C
Pristigenys alta	Short bigeye		R
Pristis pectinata	Smalltooth sawfish		R
Rachycentron canadum**	Cobia		U
Raja eglanteria	Clearnose skate		R
Raja garmani	Rosette skate		R
Raja texana	Roundel skate		C
Rhinobatos lentiginosus	Atlantic guitarfish		R
Rhinoptera bonasus	Cownose ray		R
Rhizoprionodon terraenovae	Atlantic sharpnose shark		C
Rypticus bistrispinus	Freckled soapfish		R
Rypticus saponaceus	Greater soapfish		R
Sciaenops ocellatus**	Red drum		C
Scomber japonicus	Chub mackerel		R
Scomberomorus cavalla	King mackerel		R
Scomberomorus maculatus	Spanish mackerel		U
Scorpaena grandicornis	Plumed scorpionfish		R
Scorpaena plumieri	Spotted scorpionfish		R
Selar crumenophthalmus	Bigeye scad		R
Selene setapinnis	Atlantic moonfish		U
Selene vomer	Lookdown		U
Serraniculus pumilio	Pygmy sea bass		R
Serranus subligarius	Belted sandfish		R
Sphoeroides maculatus	Northern puffer		R
Sphoeroides nephelus	Southern puffer		C
Sphoeroides spengleri	Bandtail puffer		R
Sphyraena barracuda	Great barracuda		U
Sphyraena borealis**	Northern sennet		R
Sphyraena guachancho	Guaguanche		U
Sphyrna lewini	Scalloped hammerhead		U
Sphyrna tiburo	Bonnethead		C
Squatina dumerili	Atlantic angel shark		R
Stellifer lanceolatus	Star drum		U
Stenotomus caprinus	Longspine porgy		R
Strongylura marina**	Atlantic needlefish		A

Table 3.2.2.3.3-1. Fish Species of the Mississippi Sound (Page 7 of 7)

Scientific Name	Common Name	Estuarine*	Marine Entering Estuary†
Strongylura timucu	Timucu		R
Syacium gunteri	Shoal flounder		R
Symphurus civitatus	Offshore tonguefish		C
Symphurus plagiusa**	Blackcheek tonguefish		C
Syngnathus floridae	Dusky pipefish		R
Syngnathus louisianae**	Chain pipefish		C
Syngnathus scovelli	Gulf pipefish		C
Synodus foetens**	Inshore lizardfish		C
Synodus intermedius	Sand diver		C
Trachinotus carolinus**	Florida pompano		U
Trachinotus falcatus**	Permit		R
Trichiurus lepturus	Atlantic cutlassfish		A
Trinectes maculatus	Hogchoker	A	
Tylosurus crocodilus	Houndfish		U
Urophycis floridana	Southern hake		C
Urophycis regia	Spotted hake		C

*Includes freshwater species entering estuary in addition to resident species.
†Marine species which utilize the estuarine habitat during part of their life cycles.
**Richmond's fish list for Horn Island, in Gulf Research Reports, Vol. 1, No. 2, 1962.

A=Abundant
C=Common
U=Uncommon
R=Rare

Source: Adapted from Christmas and Waller 1973.

3.2.2.3.4 **Shellfish**--The life histories of shrimp, crab, oysters, and squid have been studied primarily because of their commercial importance. With the exception of squid, these species are ecologically important as detrital feeders, and all serve as prey items for larger fish and birds. Benson (1982) summarizes current life history data in his species accounts of fin and shellfish. The biology of oysters is discussed in Christmas and Langley (1973), Bahr and Lanier (1981), and Cade (1983). Shrimp life history and catch information is given by Vittor and Associates (1985), the Gulf of Mexico Fishery Management Council (1981), and Lassuy (1983).

3.2.2.3.5 **Marine Invertebrates**--During a benthic study of Mississippi Sound conducted by Vittor and Associates, Inc., a total of 437 taxa were collected with organism densities ranging from 1,097 to 35,537 individuals per square meter. Most of the dominant species peak in production during late winter to early spring (Johnson 1980). Benthic communities of Mississippi Sound are numerically dominated by polychaetes, crustaceans, and molluscs. Coelenterates and asteroids can be important components. Numerous benthic studies document the distribution and abundance of marine invertebrates in Mississippi Sound (Vittor and Associates, Inc. 1985; Perry and Christmas 1973; Christmas and Langley 1973; Burke 1975, 1976; Cooley 1978; USACOE 1984b).

Very little is known of invertebrate communities in Back Bay of Biloxi. According to Dr. Richard Heard (1989), benthic populations in the vicinity of Keesler AFB are typical oligohaline salt marsh forms. The distribution, ecology, and taxonomy of salt marsh invertebrate assemblages is described by Heard (1982).

There is no site-specific information concerning the zooplankton communities in Back Bay of Biloxi.

3.2.2.3.6 **Commercial Species**—The commercial fishery of the Louisiana-Mississippi region has been reviewed by numerous authors (Larson, et al. 1980; van Beck, et al. 1981; Vittor and Associates, Inc. 1985; Christmas and Waller 1973; Perry 1975; Lyles 1975; Etzold and Christmas 1979; and Mississippi Department of Wildlife Conservation 1982). Mississippi Sound fisheries information was compiled by the USACOE (1984b).

Biloxi is within the "fertile fisheries crescent" described by Gunter (1963) to delineate the rich coastal area between Texas and Mississippi which supports a major commercial fishing industry. Table 3.2.2.3.6-1 presents the poundage and value of Mississippi's commercial catch for the period 1985 to 1987. The most important species landed (excluding shrimp) are by weight (in descending order): menhaden, black drum, black mullet, red snapper, blue crab, oyster, Atlantic sheepshead, blue runner, vermilion snapper, and red drum (Southeast Fisheries Center 1989).

The high fishery productivity of the area is a result of availability of nutrient-laden fresh water from rivers creating favorable estuarine conditions along coastal Mississippi. Most commercially harvested fish and shellfish are estuarine dependent during some portion of their life cycle. Their life histories are outlined by Benson (1982) and summarized by USACOE (1984b).

The Gulf Coast Research Laboratory (GCRL) has been monitoring fish populations and water quality in Mississippi Sound and various tributaries since 1973. All data are unpublished. The data collection effort is known as the GCRL Fisheries Assessment and Monitoring Program. Station 34 of the monitoring program lies in the channel in the Back Bay of Biloxi, adjacent to Keesler AFB. According to Mr. James Warren (1989), the Back Bay of Biloxi estuary is occupied by a variety of small, juvenile commercial species. The estuary is used as an important nursery area by many commercial fish and invertebrate species. The most

Table 3.2.2.3.6-1. Mississippi Finfish and Shellfish Landings by Weight (Thousands of Pounds) and Value (Thousands of Dollars) (Page 1 of 2)

	1985		1986		1987		1985-1987	
	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars
FINFISH								
Amberjack	36.76	20.92	67.40	49.50	47.51	31.49	151.67	101.91
Atlantic croaker	20.52	6.25	6.34	1.16	10.83	2.89	37.69	10.75
Black drum	2,543.11	503.22	972.36	252.73	959.53	212.02	4,475.00	967.97
Black mullet	46.35	11.60	1,125.50	385.52	585.47	238.41	1,757.32	635.53
Bluefish	0.27	0.12	4.32	1.60	1.60	0.54	6.19	2.26
Blue runner	56.68	14.76	150.72	41.88	216.40	40.10	423.80	96.74
Butterfish	5.04	1.80	4.94	2.41	60.51	35.02	70.49	39.23
Cabio	5.51	4.05	9.94	7.15	11.43	10.62	26.88	21.82
Catfish	0.18	0.09	0.00	0.00	0.00	0.00	0.18	0.09
Crevalle	0.00	0.00	0.00	0.00	4.36	0.78	4.36	0.78
Cusk	0.00	0.00	0.00	0.00	0.64	0.26	0.64	0.26
Flounder	88.21	41.22	28.13	15.04	57.31	43.07	173.65	99.33
Grouper & Scamp	41.54	43.04	41.79	42.76	32.35	33.53	115.68	119.33
Hake	0.06	0.48	0.00	0.00	0.00	0.00	0.06	0.48
Harvestfish	0.00	0.00	10.24	2.56	0.00	0.00	10.24	2.56
King mackerel & Cero	0.53	0.39	0.92	0.70	3.50	2.39	4.95	3.48
King whiting	235.44	79.42	145.54	47.52	115.90	41.87	496.88	168.81
Menhaden	415,109.20	11,213.75	353,591.83	13,218.79	380,798.52	14,521.32	1,149,499.50	38,953.86
Moonfish	0.00	0.00	35.30	10.32	0.00	0.00	35.30	10.32
Pompano	2.42	6.75	3.53	12.60	0.96	3.04	6.91	22.39
Red drum	27.42	13.08	126.35	86.70	53.06	41.32	206.83	141.10
Red snapper	937.34	1,272.05	672.66	896.20	608.61	915.34	2,218.61	3,083.59
Scamp	0.02	0.04	0.00	0.00	0.00	0.00	0.02	0.04
Scup or Porgy	10.99	5.61	15.41	13.19	15.08	14.51	41.48	33.31
Sea catfish	3.03	0.58	36.01	8.44	0.36	0.09	39.40	9.11
Shark	4.53	0.94	23.34	4.66	164.30	41.08	192.17	46.68

Table 3.2.2.3.6-1. Mississippi Finfish and Shellfish Landings by Weight (Thousands of Pounds) and Value (Thousands of Dollars) (Page 2 of 2)

	1985		1986		1987		1985-1987	
	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars
FINFISH								
Sheepshead	237.92	34.90	109.02	18.76	124.46	24.06	471.40	77.72
Spanish mackerel	18.81	6.86	42.23	13.17	54.10	16.53	115.14	36.56
Spot	1.54	0.31	1.23	0.27	3.77	0.80	6.54	1.38
Spotted seatrout	47.43	54.68	38.03	38.26	57.30	60.43	142.76	153.37
Swordfish	0.00	0.00	0.00	0.00	0.20	0.61	0.20	0.61
Ten Pounder	0.00	0.00	0.13	0.03	0.00	0.00	0.13	0.03
Tilefish	0.58	0.38	0.43	0.27	0.64	0.32	1.65	0.97
Triggerfish	0.02	0.02	4.01	1.91	5.55	2.94	9.58	4.87
Tuna	13.40	2.02	92.33	13.86	103.61	15.56	209.34	31.44
Vermilion snapper	0.20	0.36	111.00	149.85	149.40	223.12	260.60	373.33
White seatrout	47.44	16.93	60.56	21.55	60.54	16.18	168.54	54.71
Warsaw	0.42	0.38	0.00	0.00	0.00	0.00	0.42	0.38
Other finfish	528.00	51.57	561.24	64.33	681.56	76.33	1,770.80	192.23
Total Finfish:	420,070.91	13,408.62	358,092.79	15,424.14	384,989.36	16,666.57	1,163,153.01	45,499.33
SHELLFISH								
Lobster	0.00	0.00	0.46	0.57	0.13	0.13	0.59	0.70
Blue crab	1,648.90	538.02	1,302.81	469.91	1,374.10	479.81	4,325.81	1,487.74
Oyster	1,192.65	1,499.00	1,202.02	1,799.88	132.10	426.72	2,526.77	3,725.60
Squid	0.08	0.02	0.66	0.16	2.08	0.62	2.82	0.80
Total Shellfish:	2,841.63	2,037.04	2,505.95	2,270.52	1,508.41	907.28	6,855.99	5,214.84
GRAND TOTAL:	422,912.54	15,445.66	350,598.73	17,694.66	386,497.77	17,573.85	1,170,003.50	50,714.17

Source: Southeast Fisheries Center 1989.

common commercial species in the Back Bay of Biloxi estuary are brown and white shrimp, croaker, spot, sand sea trout, speckled trout, red drum, and occasionally, flounder.

Mississippi Sound oyster reefs cover approximately 10,830 acres, 70 percent of which are located south of Pass Christian in the Square Handkerchief Shoal (USACOE 1984b).

The Mississippi Department of Natural Resources (MDNR) has classified Mississippi oyster reefs as approved, conditionally approved, restricted, or prohibited. Approved waters are harvestable at all times, whereas conditionally approved waters do not meet water quality criteria at all times. Restricted waters may be harvested only if shellfish are subjected to a purification process (MDNR 1988). Purification usually requires the transfer of shellfish to leased sites north of the barrier islands (Allen 1989). Prohibited waters may not be harvested at any time. There are no prohibited waters in Harrison County. Harvesting of oysters is restricted in Back Bay of Biloxi.

3.2.2.3.7 **Threatened and Endangered Species**—Marine mammals of coastal Mississippi that are protected by state or federal legislation are listed in Table 3.2.2.3.7-1.

All sea turtle species occurring in Mississippi Sound have protective status under Mississippi state and federal legislation. The status of each species is presented in Table 3.2.2.3.7-2.

The endangered Atlantic sturgeon (*Acipenser oxyrhynchus*) is the only protected coastal fish species. The sturgeon is an anadromous species, spending much of its life in the Gulf of Mexico. It also occurs in Mississippi Sound and spawns in the Chickasawhay, Pearl, and Bogue Chitto Rivers. Sturgeon are not known to occur in Back Bay of Biloxi (MDWC 1989).

Table 3.2.2.3.7-1. Protected Marine Mammals that Occur in Mississippi Coastal Waters

Scientific Name	Common Name	Status	
		MDWC*	USFWS†
Balaena glacialis	Right whale	E	E
Balaenoptera borealis	Sei whale	E	E
Balenoptera physalus	Finback whale	E	E
Megaptera novaeangliae	Humpback whale	E	E
Physeter catodon	Sperm whale	E	E
Trichechus manatus	West Indian Manatee	E	E

*MDWC=Mississippi Department of Wildlife Conservation.
†USFWS=United States Fish and Wildlife Service.
E=Endangered.

Source: MNHP 1989.

Table 3.2.2.3.7-2. Protected Marine Reptiles that Occur in the Waters of the Northern Gulf of Mexico

Scientific Name	Common Name	Status		Habitat
		MDWC	USFWS	
AMPHIBIANS AND REPTILES				
Caretta caretta caretta	Loggerhead turtle	T	T	Tropical and temperate seas and oceans
Chelonia mydas mydas	Green turtle	E	E	Tropical and temperate seas and oceans
Dermochelys coriacea	Leatherback turtle	E	E	Open bay
Eretmochelys imbricata imbricata	Hawksbill turtle	E	E	Open bay
Lepidochelys kempi	Atlantic ridley turtle	E	E	Open bay

MDWC = Mississippi Department of Wildlife Conservation.
USFWS = United States Fish and Wildlife Service.
T = Threatened.
E = Endangered.

Source: MDWC 1989.

There are no protected shellfish species in coastal Mississippi.

There are no threatened or endangered invertebrate species in coastal Mississippi.

3.2.2.3.8 Unique and Critical Habitats—Wetlands and open water areas associated with Back Bay of Biloxi are considered to be critical habitat for a large variety of marine animals. Back Bay of Biloxi is an important nursery area for immature finfish and shellfish, providing protection and excellent food resources.

3.3 SOCIOECONOMIC SYSTEMS

3.3.1 REGION OF INFLUENCE

The proposed action will occur at Keesler AFB and the surrounding City of Biloxi, Mississippi. Biloxi is part of the Biloxi-Gulfport Metropolitan Statistical Area (MSA). The Biloxi-Gulfport MSA includes Harrison, Hancock, and Stone Counties. Jackson County is adjacent to Harrison County on the east side and Hancock County is to the west. Harrison, Hancock, and Jackson Counties form the area known as the Mississippi Gulf Coast, fronting on the Gulf of Mexico. These three counties comprise a land area of nearly 1,800 square miles. More than 16 million people live within a 400-mile radius. The limited extent of the proposed action will primarily affect Harrison County, with some minor potential for housing and related impacts in Jackson County.

3.3.2 PROJECT AREA

The cities of Biloxi and Gulfport are equidistant (73 miles) between New Orleans, Louisiana and Mobile, Alabama. Biloxi was established in 1699 by French settlers and is one of the oldest continuously occupied cities in the United States. The City of Gulfport is immediately west of Biloxi. Gulfport, platted in 1885 and incorporated in 1898, is the Harrison County seat and an active commercial port.

Keesler AFB is surrounded by the City of Biloxi and the Back Bay of Biloxi (Figure 1-1). Land around the base is primarily residential, with some commercial uses.

3.3.2.1 Demographics

Resident population in Harrison County, the second most populous county in Mississippi, has increased slowly in recent years. From 1970 to 1980, the total county population grew from 134,582 to 157,665, according to the U.S. Census. The current county population estimate is 169,421. Anticipated population growth of slightly more than 1,000 persons per year will result in a 1994 population of just over 175,000 persons. Table 3.3.2.1-1 illustrates the population estimates for Harrison County, Biloxi, and Gulfport in 1970, 1980, and 1989, with the projected increase to 1994. Biloxi is also expected to continue to gain population at a slow but steady rate. The current population estimate is 51,280 in the city, with an anticipated increase to 52,675 in 1994. Gulfport actually lost population during the 1970s, declining from 40,791 to 39,676 according to Census estimates. Recent trends indicate a slight increase in population to about 41,390 in 1989, with small gains projected to 1994. These figures reflect a stable population with balanced migration and natural population increase.

Table 3.3.2.1-2 lists population estimates for Harrison County by age groups. These figures indicate that the county population is aging, reflecting national trends. Residents under age 18 declined from 30.5 percent of the total population in 1980 to 27.6 percent in 1989. Those in the age group from 18 through 24 years of age declined 4.5 percent during the same period, from 16.5 percent of the total population in 1980 to 12.0 percent in 1989. Persons in the prime working age group from 25 to 64 years of age increased 6.3 percent, from 44.4 percent of the total population in 1980 to 50.7 percent in 1989. Elderly residents also increased slightly in numbers and percentage of total population during this period.

Table 3.3.2.1-1. Population Trends, 1970, 1980, 1989, 1994, Harrison County and Biloxi, Mississippi

Area	1970	1980	1989	1994
Harrison County	134,582	157,665	169,421	175,224
Biloxi	48,486	49,311	51,820	52,675
Gulfport	40,791	39,676	41,390	41,575

Sources: Mississippi Power Company and Urban Decision Systems 1989.
U.S. Census Bureau, Census of Population 1970 and 1980.
Van Horn Gray Associates 1989.

Table 3.3.2.1-2. Age of Population, 1980, 1989, Harrison County, Mississippi

Age	1980	Percent	1989	Percent
0-5 years	15,579	9.9	15,813	9.3
6-17 years	32,448	20.6	31,037	18.3
18-24 years	25,965	16.5	20,267	12.0
25-64	70,002	44.4	85,822	50.7
65 + years	13,671	8.7	16,482	9.7
Total	157,665	100.0	169,421	100.0

Sources: Mississippi Power Company and Urban Decision Systems 1989.
U.S. Census Bureau, Census of Population 1970 and 1980.
Van Horn Gray Associates 1989.

Table 3.3.2.1-3. Base-Related Population, 1986, Keesler Air Force Base, Mississippi

Group	Persons
Military, Personnel	13,305
Military, Dependents	15,924
Civilian, Personnel	3,446
Civilian, Dependents	5,169
Military, Students	6,132
Total	43,976

Sources: U.S. Department of the Army 1986.
Van Horn Gray Associates 1989.

Personnel assigned to Keesler Air Force Base are a significant component of the population in Harrison County. According to the 1986 Economic Resource Impact Study for the base, 13,305 military personnel were assigned to Keesler AFB. Another 3,446 civilians were employed at the base as well. Dependents of military personnel were estimated at 15,924, and students attending training at the base averaged 6,132. The population attributable to the base is summarized in Table 3.3.2.1-3. There were also over 7,700 military retirees in the area.

Total base-related population in 1986 is estimated at almost 44,000 persons. This figure includes dependents of civilian personnel estimated at 1.5 persons per civilian employee. Not all base personnel reside in Harrison County, although it is estimated that the number residing out of the county is not significant. With an estimated county population of 165,500 in 1986, it is evident that Keesler AFB supports perhaps 20 to 25 percent of the total county population.

3.3.2.2 Economic Activity

Prior to World War II, the Mississippi Gulf Coast economy was based primarily on timber, shrimping and other seafood, and tourism. The seafood and tourism industries are still vital sectors of the economy, although forestry products have become less significant. Newer industries along the Mississippi Gulf Coast produce ships, container-handling cranes, chemical products, and scientific optics, among other manufactured products. In Harrison County, the five largest manufacturers in 1986 were DuPont (chemicals), Pass Christian Industries (sportswear), Regina Co. (sweepers), Paceco, Inc. (cranes), and Gulf Publishing Company (newspaper). The presence of federal installations is significant. Besides Keesler AFB, Stennis Space Center, Naval Construction Battalion, the Air Force Medical Facility at Keesler AFB, Naval Home Residential Care Facility, and the Veterans Administration Hospital are major generators of economic activity.

Sales of goods and services is an indicator of the types of economic activities and their importance in a local economy. Table 3.3.2.2-1 shows sales in Harrison County for the fiscal year (FY) ending June 30, 1987, reported by the Mississippi State Tax Commission. Total sales during FY 1987 in the county amounted to $1.38 billion. The largest category of sales was in food and beverages, signifying the importance of the tourism industry in the county.

Estimates of annual sales potential for retail stores by store category in 1989 are provided in Table 3.3.2.2-2. These figures indicate that stores in Biloxi and Gulfport combine for over one-half of the retail sales potential in Harrison County (respectively 26.1 percent and 25.3 percent). Harrison County has four major industrial parks with over 2,100 acres designated for industrial uses. In 1985, about one-half of this land was available for new development. The parks are all serviced with water, sewer, and natural gas, and are well situated to take advantage of the water, roadway, and rail transportation facilities in the county.

Tourism is an important component of the Harrison County economy, as noted before. Lodging, restaurant, and lounge businesses employ an estimated 8,000 persons, according to the Mississippi Employment Security Commission. Convention trade by the major hotels and Mississippi Coast Coliseum and Convention Center have increased steadily over the past decade and is a primary factor in the tourism industry.

The State Port of Gulfport is another significant component of the county economy. With completion of the Tombigbee Waterway, waterborne transport shipments are projected to increase substantially over the next 20 years, although initial activity has not met expected levels. The port has deepwater facilities, a foreign trade zone, and is the primary port in the United States for receiving imports of bananas. The port is capable of handling over 1,000 ships and 1.5 million tons of cargo annually.

Table 3.3.2.2-1. Sales of Goods and Services, FY 1986-87, Harrison County, Mississippi

Sales	$ Millions
Automotive	270.6
Machinery, Equipment, Supplies	35.2
Food and Beverages	326.9
Furniture and Fixtures	37.7
Apparel and General Merchandise	180.7
Contracting, Lumber, Building Supplies	226.0
Miscellaneous Retail	91.3
Miscellaneous Services	66.5
Total Retail Sales	1,240.3
Total Wholesale Sales	73.9
Public Utilities	65.8
Total Sales	1,380.0

Sources: Mississippi Research and Development Center 1988.
Van Horn Gray Associates 1989.

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Table 3.3.2.2-2. Annual Sales Potential, Aggregate and Per Capita, 1989, Biloxi, Gulfport, and Harrison County, Mississippi

Store Category	Biloxi $000	Biloxi $per cap.	Gulfport $000	Gulfport $per cap.	Harrison $000	Harrison $per cap.
Department	21,689	495.75	20,692	536.80	82,732	514.23
Variety	1,414	32.33	1,360	35.27	5,413	33.64
Catalog	1,463	33.45	1,446	37.51	5,643	35.07
Grocery	45,283	1,035.03	41,443	1,075.15	168,380	1,046.59
Convenience	2,753	62.92	2,501	64.89	10,083	62.67
Apparel	9,595	219.30	9,247	239.89	36,409	226.30
Shoe	1,794	41.01	1,677	43.49	6,793	42.22
Jewelry	1,547	35.35	1,582	41.04	6,027	37.46
Furniture	3,673	83.96	3,547	92.01	14,044	87.29
Appliance	1,473	33.67	1,356	35.17	5,478	34.05
Restaurant	15,410	352.22	16,997	440.95	61,401	381.65
Pharmacy	9,153	209.22	8,546	221.71	32,667	203.05
Liquor	2,490	56.90	2,420	62.77	8,928	55.50
Hardware	1,605	36.69	1,707	44.28	7,020	43.63
Lumber	7,339	167.75	7,972	206.82	33,278	206.85
Lawn/Garden	503	11.49	553	14.35	2,272	14.12
Paint	724	16.55	785	20.36	3,267	20.31
Flooring	1,421	32.48	1,353	35.10	5,335	33.16
Total	129,329	2,956.07	125,184	3,247.56	495,170	3,077.79

Sources: Mississippi Power Company and Urban Decision Systems 1989.
Van Horn Gray Associates 1989.

As noted above, federal installations are also essential components of the economy. Keesler AFB is one of the world's largest electronic training facilities. Military personnel from other countries train at the base, in addition to U.S. military personnel. The Naval Construction Battalion, Atlantic Fleet, in Gulfport is one of the two "Seabee" facilities in the United States. John C. Stennis Space Center in Hancock County is a NASA facility and is also the site of the State of Mississippi Technology Transfer Center and a National Oceanographic and Atmospheric Administration office. The Technology Transfer Center administers a NASA-funded space-commercialization program.

3.3.2.3 Employment Characteristics

Labor availability in Harrison County and the 3-county Mississippi Gulf Coast region is excellent. The civilian labor force in Harrison County averaged 73,330 in 1988, according to the Mississippi Employment Security Commission. Monthly unemployment rates in 1988 ranged from a low of 6.3 percent in April to a high of 9.0 percent in November. The average annual unemployment rate for 1988 was estimated at 7.8 percent. The southern part of the state has had traditionally higher unemployment rates than the state or national averages. The number of persons in the civilian labor force in Harrison County has risen from 62,750 reported in 1980, when the average annual unemployment rate was 5.6 percent. During the 1980s, the average annual unemployment rate peaked in 1983 at 10.2 percent. Average annual employment figures for county residents and establishments in 1980, 1984, and 1988 are provided in Table 3.3.2.3-1.

It is evident from the figures in Table 3.3.2.3-1 that the county "exports" labor to adjacent counties. In each of the 3 years presented, establishment-based employment in Harrison County was reported to be less than the number of employed county residents, indicating that more county residents are employed out of the county than non-residents employed within the county. Employment centers in Jackson and Hancock

Table 3.3.2.3-1. Employment by Residence and Establishment, Harrison County, Mississippi, 1980, 1984, 1988

Employment by: Residence	1980 #	1980 %	1984 #	1984 %	1988 #	1988 %
Civilian Labor Force	62,570	100.0	67,400	100.0	73,330	100.0
Unemployed	3,490	5.6	6,170	9.2	5,690	7.8
Employed	59,080	94.4	61,230	90.8	67,640	92.2
Nonag. Wage/Sal.	53,010	84.7	55,140	81.8	61,180	83.4
Other Nonag.	5,470	8.7	5,580	8.3	6,120	8.3
Agri. Workers	600	1.0	490	0.7	340	0.5
Employment by: Establishment, Total	51,890	100.0	55,140	100.0	58,120	100.0
Manufacturing	6,440	12.4	6,780	12.3	7,420	12.8
Mining	50	0.1	50	0.1	90	0.2
Construction	2,830	5.5	3,080	5.6	2,580	4.4
Trns/Comm/Utils	3,770	7.3	3,660	6.6	3,680	6.3
Whsl/Retail Trade	12,780	24.6	15,020	27.2	15,080	25.9
Fin/Ins/Real Estate	2,390	4.6	2,750	5.0	3,080	5.3
Service & Misc.	9,040	17.4	9,430	17.1	11,120	19.1
Government	14,600	28.1	14,290	25.9	15,070	25.9

Note: Totals may not add due to rounding.

Sources: Mississippi Department of Labor and Employment Security n.d.
Van Horn Gray Associates 1989.

Counties draw from Harrison County residents for their jobs. Ingalls Shipyards in Jackson County and the Stennis Space Center complex in Hancock County are likely employment attractors for county residents.

Government employees have traditionally comprised the largest civilian employment sector in Harrison County. While persons employed in this sector have increased from 14,600 in 1980 to 15,070 in 1988, the percentage of county establishment-based employment in this sector has declined from 28.1 percent to 25.9 percent. In 1988, the wholesale and retail trade sector (15,080 jobs) equalled employment in the government sector (15,070 jobs) at 25.9 percent, and was actually a larger employment sector in 1984. Services and miscellaneous employment is the next largest sector (11,120 jobs in 1988, or 19.1 percent), followed by manufacturing (7,420 jobs in 1988, or 12.8 percent).

Employment characteristics also are reported in the decennial Census. According to the 1980 Census, 51.3 percent of the Harrison County labor force were white-collar workers. Within this classification, persons in the professional and technical category comprised 15.5 percent of the labor force, the managerial and proprietor category comprised 9.7 percent of the labor force, clerical workers were 14.3 percent, and sales employees were 11.7 percent. In the blue-collar classification, persons in the crafts category comprised 14.4 percent of the labor force, the operatives category comprised 11.3 percent of the labor force, service workers were 16.3 percent, and laborers/farm workers employees were 6.7 percent. Women comprised 47.5 percent of the labor force in 1980.

Several significant factors influenced the regional labor market during the 1980s. High unemployment levels in the mid-1980s were due to layoffs at Ingalls Shipyards in Jackson County. In less than 4 years, employment at Ingalls was reduced by about 15,000 persons, affecting all of the Mississippi Gulf Coast region. Recent shipbuilding contracts

have mitigated this situation to some degree. The downturn in the oil industry in the Gulf has also lead to job cutbacks among companies reliant upon oil and its support activities. The seafood industry has also experienced several poor seasons, due partly to fresh water flooding in Mississippi Sound. These economic factors have been offset by gains in other employment sectors in Harrison County recently, a trend which is anticipated to continue as the county's economic base diversifies.

3.3.2.4 Income

Median family income in 1989 in Harrison County is estimated to be $25,800, according to the Bureau of Economic Analysis, U.S. Department of Housing and Urban Development. The 1989 median family income nationally is $32,876. Median family income in 1979 in Harrison County was estimated to be $15,627. Adjusting the 1979 figure for inflation using the Consumer Price Index reveals that families in the county have actually gained, since the adjusted 1979 figure equals $22,405 in 1989 dollars. About 30 percent of the families in the county (those below the third decile) are earning less than $17,062. At the higher end of family income distribution, about 5 percent are earning more than $73,353. Estimates of the decile distribution of family income in Harrison County during 1979 and 1989 are shown in Table 3.3.2.4-1.

Estimates for the 1989 per capita income, distribution of household income, and average household income in Harrison County have been prepared by Urban Decision Systems for Mississippi Power Company. These figures are shown in Table 3.3.2.4-2, with the 1980 Census estimates and projections for 1994. Per capita 1989 income in the county is reported at $10,320, median household income at $21,623, and average household income at $27,090. About one-third of the households in Harrison County earn more than $30,000, and one-third earn less than $15,000. Per capita 1994 income in the county is projected to be $12,831, median household income of $26,216, and average household income at $32,394.

Table 3.3.2.4-1. Decile Distribution of Family Income 1989, Harrison County, Mississippi ($)

Decile	1	2	3	4	median	6	7	8	9	9.5
1979	4,976	7,682	10,335	12,770	15,627	18,722	22,270	26,802	34,599	44,430
1989	8,215	12,682	17,062	21,083	25,800	30,909	36,767	44,249	57,122	73,353

Source: U.S. Department of Housing and Urban Development 1988.

Table 3.3.2.4-2. Household Income, 1980 and 1989 Estimates, 1994 Projections, Harrison County, Mississippi

Income Range	1980 Census		1989 Estimate		1989 Projection	
	#	%	#	%	#	%
Households	52,202	100.0	62,106	100.0	67,050	100.0
Less than $5,000	8,355	16.0	5,007	8.1	3,578	5.3
$5,000-9,999	10,590	20.3	7,930	12.8	6,923	10.3
$10,000-14,999	9,892	18.9	8,064	13.0	7,952	11.9
$15,000-19,999	7,532	14.4	7,943	12.8	7,049	10.5
$20,000-24,999	5,407	10.4	6,501	10.5	6,640	9.9
$25,000-29,999	3,873	7.4	5,207	8.4	5,688	8.5
$30,000-34,999	2,406	4.6	4,352	7.0	4,718	7.0
$35,000-39,999	1,357	2.6	3,583	5.8	4,019	6.0
$40,000-49,999	1,395	2.7	5,523	8.9	6,582	9.8
$50,000-74,999	974	1.9	5,561	9.0	9,200	13.7
$75,000 and over	424	0.8	2,435	3.9	4,702	7.0
Per Capita Income	$5,813		$10,320		$12,831	
Median HH Income	$13,405		$21,623		$26,216	
Average HH Income	$16,689		$27,090		$32,394	

Sources: Mississippi Power Company and Urban Decision Systems 1989.
Van Horn Gray Associates 1989.

3.3.2.5 Land Use

Harrison County has an appointed Planning Commission, which is responsible for the County Comprehensive Plan. The Comprehensive Plan addresses land use and other issues in the unincorporated areas of the county. Subdivision regulations and a flood prevention ordinance have also been adopted by the county, but land in the unincorporated areas is not zoned. The cities of Biloxi and Gulfport have comprehensive plans, zoning and subdivision regulations, and flood prevention ordinances. The county and the two cities maintain a building and housing permit system, with adopted codes for building, housing, plumbing, electrical, and gas connections. Keesler AFB, as a United States military facility, is under federal jurisdiction and not subject to local comprehensive plans and land development regulations except as a matter of base policy on intergovernmental coordination.

Land uses adjacent to the base are well established, and no significant changes are anticipated by the Comprehensive Plan for Biloxi, according to City of Biloxi Community Development Department staff. Land use immediately east is predominantly residential. Further east lies the downtown area of Biloxi at the eastern tip of the peninsula. Between Irish Hill Drive and U.S. 90 on the southern side of the base is a single family residential area and a school. Commercial and recreational uses line Highway 90 south of the base fronting on Mississippi Sound (Figure 1-1). West of the base, land is also residential in character, with commercial strip development along Pass Road. The Veterans Administration Medical Center is located in this area as well. North of the base is the Back Bay of Biloxi.

The most recent Comprehensive Plan for Biloxi was completed in 1979. The Land Use Element of the plan identified approximately 2,975 acres of low-density residential land uses, 858 acres of medium- and high-density residential uses, 884 acres of commercial uses, and 134 acres of industrial uses. Actual land uses covered 4,879 acres of the total

7,057 acres of zoned land in the city. Over 1,300 acres of vacant, zoned residential land existed in the city at the time the plan was implemented. The plan noted that 1,329.8 acres of land for Keesler AFB was not under city jurisdiction, but recognized the importance of this facility for the city and stated that future coordination of common needs between the base and the city would support "sound and progressive growth" for the city.

3.3.2.6 Housing

The 1980 Census of Housing reported 57,954 total housing units in Harrison County. Owner-occupied units totalled 32,451 (56.0 percent) and renter-occupied units totalled 19,751 (34.1 percent). Vacant units accounted for 5,410 units, or a vacancy rate of 9.3 percent. Units held for seasonal and occasional use were estimated at less than 1 percent of the inventory. Over 60 percent of the housing units had been constructed since 1960, and consequently, most units were reported as being in sound condition.

Current housing inventory estimates indicate about 38,300 owner-occupied units and 23,797 renter-occupied. Vacancy rates still range between 5 and 10 percent on an annual basis, so available inventory offers a wide selection of housing types in both for-sale and for-rent units. Based on community surveys by Mississippi Power Company, housing availability remains good. Housing affordability also remains satisfactory, given average income levels and recent sales prices for homes. The average price of a three-bedroom, two-bath detached single-family house in 1988 was $60,800.

3.3.2.7 Transportation System

The transportation system along the Mississippi Gulf Coast is one of the best attributes of the region. Easily accessible modes of transport include inland navigable water, rail, interstate highway, general and commercial aviation, and deepwater ports. The coastal ports and harbors

along the Mississippi Gulf Coast have been important to the region since the early days of European exploration. Today, the State Port at Gulfport and another deepwater port at Pascagoula provide international connections to other regions via the Intracoastal Waterway and the Tennessee-Tombigbee Waterway. The Mississippi State Port is the only containerized shipping port on the Mississippi Gulf Coast.

CSX System and MidSouth Rail serve the region with rail lines and cargo transportation. Rail lines connect the ports and industrial parks and also run north to Hattiesburg, Mississippi, intersecting with other major rail carriers. Gulfport-Biloxi Regional Airport is served by commuter flights and daily flights by three major commercial airlines. The 9,000-foot runway is adequate to accommodate many modern jet aircraft.

The roadway network in the county links with Interstate 10, which is the county's primary east-west surface transportation corridor. The coast is bordered by U.S. 90, a 4-lane arterial road. State Road 15 provides north-south access from Biloxi and is paralleled by the recently completed I-110 Connector to I-10. U.S. 49 provides north-south access from Gulfport. State Roads 53 and 67 are located in the county. Harrison County is also served by at least 12 motor freight carriers, and ABF Freight System maintains a terminal facility in the county. Major local roadways in Biloxi include Pass Road, which is an east-west arterial route terminating on the west perimeter of Keesler AFB, Irish Hill Drive, which borders the south side of Keesler AFB, Porter Street, Division Street, and Howard Street. Mass transit services are provided to Biloxi and Keesler AFB by Coastal Area Transit, a regional transit system. Greyhound and Trailways serve the area with interstate bus lines.

3.3.2.8 <u>Public Utilities and Services</u>

Public utilities and services assessed for this report include potable water supply and distribution, wastewater collection and treatment,

electrical power, natural gas, solid waste collection and disposal, and communications systems.

3.3.2.8.1 **Water Supply**--Harrison County and the county municipalities draw their potable water from groundwater sources. The artesian aquifers used for supply provide water which meets or exceeds drinking water standards. Biloxi maintains a 15.0 million gallon per day (MGD) system with storage capacity of 5.0 MGD (2.0 MGD elevated). Peak demand is approximately 12.0 MGD. Gulfport maintains an 12.0-MGD system with storage capacity of 3.0 MGD. While saline intrusion has not been a problem in the past with these coastal wells, increased salinity has occurred at wells in the Gautier area in adjacent Jackson County.

Keesler AFB has its own wells for water supply. The water supply distribution system at the base is adequate, although its age and local soil conditions have caused some deterioration in the underground cast iron pipes. The base has a replacement program underway. The system is sized to accommodate larger personnel complements than current demand. Water wells serving the base are almost 50 years old, having been installed when the base was constructed during World War II. Well depths have been extended several times, due to a problem with draw-down, but some of the wells are being recased and deepened to alleviate the problem. The Keesler AFB water supply system also serves the Veterans Administration Hospital.

3.3.2.8.2 **Wastewater**--The Harrison County Wastewater Management District, and the Cities of Biloxi and Gulfport provide sanitary sewers and wastewater treatment services in the region. The Biloxi system has a capacity of 4.2 MGD, and 98 percent of the city utilizes sanitary sewers. There is no sewage treatment plant at Keesler AFB. Wastewater from the base goes to a regional wastewater treatment plant. The wastewater collection system (sewerage) is adequate, but there is a problem with the lift station pumping to the regional treatment plant

west of the base. This lift station is connected to the treatment plant via a 20-inch force main. It is at capacity now and overflows during heavy rains. The regional treatment plant has adequate capacity to serve the base at full demand.

3.3.2.8.3 **Electrical Power**—Electrical power in Harrison County is supplied and distributed by Mississippi Power Company and Coast Electric Power Association. Coast Electric Power Association operates a coal-fired generating plant in the county. Generating capacity is rated at 1.97 million kilowatts (kW), with system demand at 1.59 million kW. Adequate electrical power capacity to serve the county is available, according to the Southern Mississippi Planning and Development District.

3.3.2.8.4 **Natural Gas**—Natural gas is distributed by ENTEX, Inc., which is supplied by United Gas Pipeline Company. Fuel oils and liquid propane are available from local suppliers. The natural gas distribution system on-base has problems similar to the water distribution system, due to the age and condition of the metallic pipes. An annual gas leak survey is conducted and several lines have already been replaced with high-density plastic pipe. Adequate natural gas supply to serve the county is available, according to the Southern Mississippi Planning and Development District.

3.3.2.8.5 **Solid Waste Systems**—Solid waste collection services in the county are provided by private contract haulers, including Waste Management and Browning-Ferris Industries (BFI). Fountain Enterprises is the solid waste hauler serving Keesler AFB. Disposal is at sanitary landfills. No problems with solid waste collection and disposal are anticipated at present rates of growth, although secure landfill sites will be needed in the future.

3.3.2.8.6 **Communication Systems**—South Central Bell Telephone Company provides local telephone services. Several long distance carriers are available. There are two local television stations, WLOX and WXXV, and

cable television service is available from Post-Newsweek Cable Company. Radio stations in the region include 12 AM and 12 FM stations. Two daily newspapers are published locally, the Sun-Herald and the Mississippi Press. Keesler AFB also has its own newspaper.

3.3.2.8.7 **Education**—Mississippi passed the Education Reform Act in 1975, with the purpose of improving the overall quality of the State's comprehensive education system. Primary and secondary schools in the Mississippi Gulf Coast region rank highly in academic test scores. Branch campuses of the University of Southern Mississippi and William Carey College serve local higher education students. The University of Southern Mississippi also provides some classes at Keesler AFB. Mississippi Gulf Coast Community College branches also serve the area, and include vocational-technical training programs. According to the 1980 U. S. Census of Population, 67.7 percent of Harrison County's residents over age 25 had completed high school, and 13.9 percent had 4 or more years of college.

Harrison County has five public school districts. Biloxi Municipal Separate School District had 11 elementary schools and 1 secondary school with a student enrollment of 6,756 during the 1987-88 school year. Five private and parochial schools in the city had an enrollment of 966 during the 1987-88 school year. The schools have adequate capacity to accommodate new students.

3.3.2.8.8 **Public Safety**—On the peninsula, the Cities of Biloxi and Gulfport provide municipal public safety services. Biloxi had 72 full-time fire and emergency response personnel in 1988, with 11 major fire-fighting vehicles. The fire insurance rating by Insurance Services Organization (ISO) was "5" for Biloxi. Gulfport had 95 full-time and 14part-time fire and emergency response personnel in 1988, with 15 major fire-fighting vehicles (including 2 rescue boats). The fire insurance rating by ISO was "4" for Gulfport. Mutual response and aid agreements

have been signed by the county and the two cities. Keesler AFB also provides its own fire protection and emergency response assistance. Harrison County is responsible for public safety services in the unincorporated areas of the county.

3.3.2.8.9 Law Enforcement—In 1988, the Biloxi Police Department had 60 full-time and 50 part-time personnel, and 35 patrol cars. Gulfport had 99 full-time and 14 part-time personnel, and 75 patrol cars. Keesler AFB also provides its own law enforcement and security. Harrison County and the State Highway Patrol are responsible for law enforcement in the unincorporated areas of the county.

3.3.2.8.10 Health Care—Health care facilities and services in Harrison County are adequate, according to the Southern Mississippi Planning and Development District. Five hospitals and four medical clinics are located in the county. There are two significant federal facilities in addition to the excellent public and private medical facilities. The Veterans Administration Medical Center is a 1,133-bed facility providing medical, surgical, and psychiatric services. The Air Force Medical Facility at Keesler AFB is the second largest in the United States. As of June 1985, state-licensed medical personnel in the county included 145 physicians, 67 dentists, 838 registered nurses, and 547 licensed practical nurses.

3.3.3 CULTURAL RESOURCES

As an area with a rich history, and an aboriginal as well as early colonial settlement, the possibility exists that archaeological or historic artifacts may be uncovered during construction. Any such finds should be reported to the Mississippi State Office of Historic Preservation. Utilization of the existing facilities at the base is unlikely to impact significant archaeological resources. No historic or cultural resources listed or eligible for listing on the National Register of Historic Places exist on Keesler AFB property. The nearest historic sites are

located in the City of Biloxi, but are not within the immediate project vicinity on-base and will not be impacted by the proposed project. Designated historic districts in the city include Point Cadet Waterfront, Howard Avenue, Water Street, and East Beach Biloxi. Developments in these districts are reviewed by the city to insure design compatibility, and sensitivity to existing district character.

4.0 ENVIRONMENTAL AND SOCIOECONOMIC CONSEQUENCES

4.0 ENVIRONMENTAL AND SOCIOECONOMIC CONSEQUENCES

This section addresses the environmental and socioeconomic impacts of the proposed action to relocate the Weather Training Division from Chanute AFB (Rantoul, Illinois) to Keesler AFB (Biloxi, Mississippi).

4.1 DIRECT EFFECTS AND THEIR SIGNIFICANCE

Both positive and negative effects of the proposed action must be considered to determine what direct impact the relocation of the Weather Training Division and associated personnel will have on Keesler AFB and the surrounding area.

4.1.1 PHYSICAL SYSTEMS

Effects of the proposed action on the physical systems of the area are discussed in the following sections.

4.1.1.1 Geology and Physiography

No significant direct effects on the geology, topography, sediments, or bathymetry of the area are anticipated from the proposed action.

Soil erosion may temporarily increase at the construction site of the Weather Training Facility, due to removal of the impervious parking surface and excavation required. The soil at the proposed construction site is Eustis loamy sand, 0 percent to 5 percent slope. Soil blowing is a potential problem for this soil type when the soil is left bare and unprotected during a dry period (Smith 1975). This impact can be minimized by designing an interim site drainage plan utilizing proper erosion protection techniques.

Dormitory and Dining Hall renovation projects should not significantly affect surrounding areas, because most renovation activities will occur in the interior of the buildings. It will not be necessary to expose soils previously protected by plant cover or pavement at these two locations.

NEXRAD will be constructed off Keesler AFB. The soils at the proposed site are Ruston fine, sandy loam (RuB and RuC) and the slope ranges from 2 to 8 percent. These soils have slight to moderate erosion potential, moderate permeability, and medium to high water capacity. Proper erosion control techniques during construction will prevent significant negative impacts on the local soils.

4.1.1.2 Surface Water

Surface waters are not expected to be significantly impacted by the proposed construction and operation of the Weather Training Facility. Because Eustis soils have moderately rapid permeability, and the slope at the Weather Training Facility site is less than 5 percent, very little runoff is expected (Smith 1975). However, some soil erosion could be caused by the removal of the impervious parking surface, and subsequent excavation of building foundations could cause a temporary, localized decrease in the quality of water receiving the stormwater runoff. Appropriate construction practices should be employed to minimize soil erosion. Temporary increases in suspended solids loading could occur as a result of erosion. No significant increase in paved area is projected, so there are not expected to be significant temporary or permanent direct impacts on estuarine water quality due to accumulated pollutants washing from impervious surfaces.

No impact on surface waters is expected during renovation of the dormitory or dining hall since the majority of this work will be done on the interiors of these facilities. Pollutants which accumulate on pavement due to operation of construction machinery should affect stormwater runoff only slightly.

The NEXRAD facility site is near the headwaters of Howard Creek. Stormwater runoff during construction of the radar installation could temporarily wash eroded soils and accumulated petroleum residuals from construction vehicles into the creek, but the impact of this runoff is expected to be minimal.

4.1.1.3 Groundwater

No significant increase in water usage is anticipated due to construction or operation of the Weather Training Facility, renovation of Dining Hall and Dormitory facilities, or construction of NEXRAD. Thus, the regional groundwater resources of the Biloxi area would not be directly impacted by this project. Local, shallow water tables may change as a result of construction activity, but the deeper aquifers would not be affected.

Because Navy policy (OPNAVINST 5090.1) requires that the handling and disposal of hazardous wastes generated from the proposed facility meet all federal, state, and local regulations, no significant impact on groundwater quality is expected.

4.1.1.4 Air Quality

No significant decrease in air quality is expected as a direct result of operation of the Weather Training Facility and NEXRAD, or of the renovation of Dormitory and Dining Hall facilities. Some localized temporary effects on air quality are expected as a result of construction. Potential air emission sources would primarily include diesel construction equipment. Because of the limited amount of construction traffic expected, construction equipment emission should be of relatively small quantity.

During ground clearing and excavation phases of construction of the Weather Training Facility and NEXRAD, temporary increases in dust emission is likely in the vicinity of the construction site. Most dust generated will typically be of large particle size and settle out close to the source. The finer components of these dusts [i.e., those less than 10 um (micrometers) in diameter] would remain suspended in the atmosphere. Modern methods of dust control should be used, in order to insure that fugitive dust emissions comply with Mississippi air quality regulations which require that all reasonable precautions be taken to prevent fugitive dust emissions.

Asbestos is known to be present in the buildings slated for demolition to make way for the Weather Training Facility (Rackerd 1989). Proper removal and disposal techniques should be utilized to ensure the safety of construction workers. Asbestos removal has been included in the $290,000 cost of relocation and demolition (USAF 1989a). Other air quality impacts caused by renovation of the Dormitory and Dining Hall are expected to be limited to increased emissions from vehicles transporting workers and materials.

4.1.1.5 Noise

No significant noise impacts are expected by operation of the Weather Training Facility or NEXRAD, or by usage of the Dining Hall and Dormitory.

The Dining Hall and Dormitory slated for renovation are both located within the 75-dBA noise contour. Construction noise caused by indoor renovations is projected to be minimal, compared to the high ambient level of noise in the area.

Construction of the Weather Training Facility is expected to occur over an 18-month period. The following construction activities will take place on the site: ground clearing, excavation, foundation construction, installation, and finishing. Heavy machinery will be required for earth-moving, materials handling, and construction. Table 4.1.1.5-1 lists sound levels associated with such activities. The project is located near an active airfield, within the 75-dBA noise contour. Additional noise generated by construction activities is not expected to significantly affect human activities already being conducted in the area.

NEXRAD is slated for construction in a wooded, unpopulated area. Construction noise is not projected to impact human activities.

Table 4.1.1.5-1. General Services Administration Construction Noise Maximum Permissible Limits

Equipment	dBA
EARTHMOVING	
Front Loaders	75
Backhoes	75
Dozers	75
Tractors	75
Scrapers	80
Graders	75
Trucks	75
Pavers	80
MATERIALS HANDLING	
Concrete mixers	75
Concrete pump	75
Cranes	75
Derricks	75
STATIONARY	
Pumps	75
Generators	75
Compressors	75
IMPACT	
Pile Drivers	95
Jack Hammers	75
Pneumatic Tools	80
OTHER	
Saws	75
Vibrator	75

Note: All noise limits in dBA measured at a distance of 50 feet from the equipment.

Source: SOUTHDIVNAVFACENGCOM 1986b.

4.1.2 BIOLOGICAL SYSTEMS

This section will discuss any effects the proposed action will have on the biological systems of the area.

4.1.2.1 Vegetation

Except for the possible removal or destruction of any existing lawn grasses during construction of the Weather Training Facility, no terrestrial vegetation would be directly impacted by the proposed project. It is the policy at Keesler AFB to preserve significant natural resources. Therefore, mature live oaks existing at the Weather Training Facility construction site will not be affected by the proposed action. No significant impacts to the terrestrial vegetation are expected from the renovation of the Dining Hall and Dormitory facilities because most renovation is scheduled for the inside of the buildings. It will not be necessary to remove existing vegetation during renovation projects. Installation of the NEXRAD system would result in the elimination of approximately 10,000 square feet of natural pine forest. Aquatic flora would not be directly affected by any of the proposed construction or renovation projects, because all project sites are located in upland areas.

4.1.2.2 Wildlife

No wildlife or wildlife habitat would be directly impacted by the construction or operation of the Weather Training Facility. Given the urban nature of the existing construction site, no change in occurrence of wildlife species at Keesler AFB would be expected as a result of construction. No direct impacts to wildlife would be caused by the renovation of the Dormitory and Dining Hall facilities, because these projects will take place indoors. Construction of the NEXRAD system would have no direct affect on wildlife, other than the possible removal of wildlife habitat, including a small number of pine trees and approximately 10,000 square feet of understory vegetation. The construction site is adjacent to a U.S. Air Force firing range. No direct impacts to wildlife are expected to occur during future operation of the NEXRAD

system (NEXRAD PEIS 1984). The frequency emitted by NEXRAD (2,870 to 2,880 megahertz) and the three pulse-repitition frequencies from 500 to 1,200 pulses per second are well above the extremely low frequencies (0 to 100 hertz) known to affect some animals.

Since all renovation and construction sites are upland, no aquatic animals would be directly affected by any of the proposed projects.

4.1.3 SOCIOECONOMIC SYSTEMS

Effects of the relocation of the Weather Training Division on the socio-economic systems of the Keesler AFB/Biloxi area are discussed in the following sections.

4.1.3.1 Demographics

Student loadings and permanent party personnel at Keesler AFB will increase from present levels as a result of the training activities realignment from Chanute AFB. Current student loadings at Keesler are at an historical low. Student loadings for Weather Operations Division at Chanute averages about 376 daily, with approximately 10 to 12 officers. Students in the Weather Equipment Division average about 100 daily. The length of stay averages 51 days for TATB (Weather Course - Technician), 112 days for TATC (Weather Course - Officer), and 12 days for TATD (Advanced Weather Course - Officer), with all classes normally full. Permanent party military personnel and civilian employees to be transferred include an estimated 20 officers, 158 enlisted personnel, and 65 civilians, totalling 243.

Chanute AFB Housing Services reports about 2.5 dependents per unit, each with an average of 1 spouse and 1.5 children. The number of incoming personnel with spouses is reported to be 154, with an additional 385 dependent children. The estimated change in permanent area resident population is 782, which includes military personnel, civilians, and dependents. In addition, the average student population is expected to be 476 at any given time. Dependent children are estimated to include

195 under age 5 years, 116 between the ages of 5 and 12 years, and 74 between the ages of 12 and 18 years.

Combining the estimated permanent population increase with the average student increase to the area, the total population increase will average 1,258 persons at any given time, depending on the number of students assigned to the base for training. This increase is less than 1 percent (0.7 percent) of the current county population estimate of 169,421. The projected personnel at Keesler in FY 92 without the additional personnel from the realignment of activities from Chanute AFB is 12,903, including 7,963 permanent party and 4,939 students. Permanent party personnel (military and civilian) will increase by 3.1 percent and student population will increase by 9.6 percent.

4.1.3.2 <u>Economic Activity</u>

Economic activities resulting from the relocation of the Weather Training Division to Keesler AFB include temporary construction employment, increased materials and services procurement for construction activities, increased employment on a permanent basis, increased indirect (secondary) employment due to increased population and income in the region, and increased sales of goods and services on a permanent basis.

Dormitory and Dining Hall renovation, and construction of the Weather Training Facility are FY 91 projects. The project cost estimate for alteration of the Dormitory and Dining Hall is $1.5 million. The project cost estimate for construction of the training complex and other facilities for Weather Operations and Weather Equipment activities is $8.6 million. These activities will be initiated in October 1989 and completed by May 1992, according to relocation timeline estimates prepared by the Air Force. By July 1992, all training activities should be transferred from Chanute AFB to Keesler AFB, and new classes begun.

The total economic impact of Keesler AFB on the region was estimated at $365.7 million in 1986, according to the Economic Resource Impact

Statement. Military payroll totalled $286.6 million, and civilian payroll totalled $76 million. Additional income from payroll for the realigned personnel is addressed in the Income section below. The estimated value of services and supplies attributable to the realigned activities for expenditures to contractors is $1.44 million annually. The estimated value of operations and maintenance expenditures attributable to the realigned activities is $575,000 annually.

Per capita retail expenditures for the 782 permanent residents estimated to be attributable to the realigned activities can be derived from the estimates of store sales potential provided in Table 3.3.2.2-2. Using the Biloxi estimate of $2,956.07 per capita, per capita expenditures for the permanent residents in the region will be approximately $2.31 million. Expenditures for housing and utilities will also have a direct positive impact on the region. Expenditures by students will have different characteristics, since they will be housed on-base. However, some of their income will be spent in the regional economy, adding to the net gain in expenditures.

4.1.3.3 Employment

As noted in Section 4.1.3.1, permanent party military personnel and civilian employees to be transferred include an estimated 20 officers, 158 enlisted personnel, and 65 civilians, totalling 243. Direct permanent employment will therefore be 243, plus an undetermined number of workers for independent contractors supplying goods and services for the realigned activities.

Indirect employment will include workers supported in the region by additional expenditures in the regional economy derived from increased local income. The number of spouses estimated to seek work in the region is 92. Although the region has had a relatively high unemployment rate during the past decade, employment increases recently indicate a strengthening of the economy, and more support for added jobs.

4.1.3.4 Income

Using military and civilian pay scales, and assuming a mid-range for each grade, estimates of increased income attributable to the realigned activities can be derived. The average rank for students is A1C, with time in service typically less than 2 years. Sergeants average 6 to 10 years service. The estimated annual basic payroll derived from the realigned activities is approximately $611,000 for officers, $2.4 million for enlisted personnel, $1.88 million for civilian employees, and $4.9 million for students. These figures are shown in Table 4.1.3.4-1 and do not include Basic Quarters Allowance, Incentive Pay, or Subsistence Pay for military personnel.

The total estimated payroll for permanent personnel is about $4.9 million. Most of this income will stay in the region in the form of living expenses, savings, and investments. Student payroll, based on an average of 476 students at a given time is also about $4.9 million. However, since these students are only stationed at the base for the duration of their training, much less of their income will enter the local economy.

4.1.3.5 Land Use

No significant land use incompatibilities between the base and the city were identified. Land use on-base is largely set, as much of the base is developed and the locations of the new facilities have been determined. Installation of a radar facility in the National Forest should insure that there are no negative effects from the installation on adjacent lands.

4.1.3.6 Housing

It is anticipated that 90 percent of the incoming military personnel and all of the civilians will be housed off-base. Approximately 225 housing units will be required for permanent employees and their families. The City of Biloxi had 176 for-sale and 653 rental units vacant as of

Table 4.1.3.4-1. Estimated Annual Basic Payroll, Proposed Activities Realignment, Keesler Air Force Base, Mississippi

Rank	Number
Officers	$ 611,000
Enlisted	2,432,000
Civilian	1,878,000
Subtotal:	4,921,000
Students	4,906,000
Total:	$9,827,000

Source: Van Horn Gray Associates 1989.

February 1988. The housing inventory in the region has sufficient vacancies and selection to accommodate the incoming personnel. The Triangle housing area (student dorms) on-base will be renovated to house the students.

4.1.3.7 <u>Transportation System</u>

Four principal problems with traffic at Keesler AFB have been identified in the base master plan. A lack of parking, several problem intersections, and traffic congestion at peak travel times creates circulation problems. The base has undertaken to improve these problem areas through implementation of the recommendations provided in a recent Military Traffic Management Command study, including new signage, signalization, and limiting student vehicles on-base. Most students will not have vehicles, and parking is adequate in the Triangle housing area (student dorms). Coastal Area Transit has four or five stops on-base. Table 4.1.3.7-1 shows the 24-hour traffic volumes, by gate, at Keesler AFB. Construction of the new facilities should provide adequate parking for instructors and staff.

4.1.3.8 <u>Public Utilities and Services</u>

4.1.3.8.1 <u>Water Supply</u>—The existing water distribution system will be used for these activities. Water supply is adequate to meet the needs attributable to the proposed action.

4.1.3.8.2 <u>Wastewater</u>—Wastewater generated will be primarily domestic sewage. Using a wastewater generation rate of 105 gallons per day for students, less than 200,000 gallons of wastewater per day will be generated on-base, primarily at the housing area and training facilities. Wastewater will be pumped through the existing sewerage system to the Regional Treatment Facility, which has adequate capacity to handle the additional loading.

Table 4.1.3.7-1. 24-Hour Traffic Volumes, by Gate, Keesler Air Force Base, 1987

Gate	Hours Open	Inbound	Outbound	Total
1	open 24 hours	4,675	4,685	9,360
2	0500-2230 daily	4,444	2,199	6,643
3	open 24 hours	5,100	5,196	10,296
7	open 24 hours	7,746	9,561	17,307
9	0500-2230 daily	na	na	na
Total	52,202	62,106	21,641	43,606

Sources: U.S. Department of the Army 1987.
Van Horn Gray and Associates 1989.

4.1.3.8.3 <u>Electrical Power</u>—Electrical power supply will be provided by the existing base electrical distribution system. The primary distribution line is adequate to meet demands attributable to the realigned activities. Stand-by electrical power is not required for the Weather Training Facility. The Weather Training Facility will require substantial power due to the extent of the equipment and the cooling requirements for the facility.

4.1.3.8.4 <u>Natural Gas</u>—Each of the dormitories has a self-contained heating plant with two gas-fired 3.58-million-Btu-per-hour boilers. Natural gas supply is adequate to meet the needs attributable to the proposed action.

4.1.3.8.5 <u>Solid Waste Systems</u>—Solid waste collection and disposal service is adequate to meet the needs attributable to the proposed action. Construction waste will be the responsibility of the contractor(s). Disposal of all solid wastes will be in accordance with federal, state, and local regulations.

4.1.3.8.6 <u>Communication Systems</u>—Public pay phones will be placed in each dayroom in the dormitories. Cable television outlets will be placed in each dayroom and bedroom.

4.1.3.8.7 <u>Education</u>—An estimated 190 school-age children will accompany incoming personnel. At a standard ratio of 1 teacher per 25 students and 1 administrative employee per 70 students, about 10 elementary and secondary school employees will be required for the new students. It is likely, however, that the student population will be distributed among several school districts and the impact will be accommodated by existing system capacities.

4.1.3.8.8 <u>Public Safety</u>—The Air Force provides fire protection and emergency response services on-base. There are no formal interlocal

agreements with local fire/rescue departments. Automatic fire alarm and detection systems will be installed in the Weather Training Facility and dormitories.

4.1.3.8.9 <u>Law Enforcement</u>—The Air Force provides security and law enforcement services on-base. There are no formal interlocal agreements with local police departments. The base is under federal jurisdiction, and the Air Force and/or the FBI are the investigating law enforcement agencies. Local police have jurisdiction in the cities and county.

4.1.3.8.10 <u>Health Care</u>—As with any given population, bodily injuries and illnesses will occur among both the student and permanent population, requiring medical attention. Medical facilities available in the region and on-base are adequate to handle the increased incidence of injuries and illnesses attributable to the realigned personnel, their dependents, and students.

4.1.4 CULTURAL RESOURCES

No historic or cultural resources listed or eligible for listing on the National Register of Historic Places exist on Keesler AFB property. The nearest historic sites are located in the City of Biloxi, but are not within the immediate project vicinity on-base and will not be impacted by the proposed project. As an area with a rich history, and an aboriginal as well as early colonial settlement, the possibility exists that archaeological or historic artifacts may be uncovered during construction. Any such finds should be reported to the Mississippi State Office of Historic Preservation. Utilization of the existing facilities at the base is unlikely to impact significant archaeological resources.

4.2 INDIRECT EFFECTS AND THEIR SIGNIFICANCE

In addition to considerations of direct effects, secondary or indirect effects of the proposed action must be considered. These effects include the potential for associated investments and changes in the

patterns of social and economic activities. Increases in demand on natural and cultural resources of the area due to increases in population associated with the proposed action must also be considered.

4.2.1 PHYSICAL SYSTEMS

The proposed action is projected to bring 243 permanent personnel into the Gulf Coast area. In addition, there are expected to be 476 temporary personnel on-base at any one time. The families of the military and civilian personnel assigned to the Weather Training Facility will also increase the population of the region. Many of these personnel will own and use automobiles, contributing to noise and air pollutant emissions. Automobiles also have a detrimental effect on surface water quality, by increasing the amount of petroleum residuals which are carried off roadways by stormwater runoff.

Although there are projected to be sufficient homes available to house the population increase, construction of any new homes will cause temporary impacts similar to those described for construction of the Weather Training Facility.

The increase in population will mean an increase in the use of potable water, hastening the drawdown in municipal wells. Saltwater intrusion and water-level drawdown have been projected for the Gulf Coast area (Sumner, et al. 1987). These problems will increase as the population rises. The relatively small increase in population associated with this action will most likely not affect groundwater levels greatly. However, it is important for a region to anticipate cumulative impacts of small projects such as this when planning for future water uses.

Although wastewater treatment has been shifted off-base to a regional water treatment plant, Keesler AFB is still responsible for pumping wastewater to a city collection system which forwards it to the regional plant. The lift station on-base is currently operating at maximum

capacity, and overflows in periods of heavy rain (Hase 1989). An increase in personnel will increase wastewater, thus increasing the frequency and amount of overflow. Since all surface runoff eventually reaches Mississippi Sound or Back Bay of Biloxi, an increase in wastewater could potentially affect water quality in these estuaries.

4.2.2 BIOLOGICAL SYSTEMS

Secondary effects of the proposed action to relocate the Weather Training Division to Keesler AFB are those related to the influx of additional personnel assigned to Keesler AFB and their dependents. Although it is anticipated that sufficient housing exists for incoming permanent personnel, any home construction required for new personnel may result in the elimination of some upland vegetation and wildlife habitat. Other potential impacts as a result of additional home construction would be similar to those described in Sections 4.1.2 and 4.4.2, in relation to the construction of the Weather Training Facility. The impacts to physical systems discussed in Section 4.2.1, such as reductions in air and water quality and the potential for saltwater intrusion, are not expected to significantly influence vegetation and wildlife communities. Increased overflow of wastewater from the Keesler AFB wastewater pumping station would potentially affect marine biota in Back Bay of Biloxi, but this problem, if it occurs, can be easily corrected.

4.2.3 SOCIOECONOMIC SYSTEMS

The relocation of the Weather Training Division from Chanute AFB to Keesler AFB will result in positive indirect impacts on the regional economy through the secondary effects of income and employment generated by Air Force procurement of materials and services, and expenditures by personnel for goods and services.

4.3 POSSIBLE CONFLICTS BETWEEN THE PROPOSED ACTION AND THE OBJECTIVES OF FEDERAL, REGIONAL, STATE, AND LOCAL LAND USE PLANS, POLICIES, AND CONTROLS

There are no identified conflicts with local government land use plans, policies, or controls as a result of this project. Keesler AFB is a federal reservation and as such is not subject to local plans, policies, and controls, except as a matter of policy for intergovernmental coordination and community interest. All building construction, including any additional new housing, will be in areas zoned for the type of construction proposed for the area. In addition, the design of the new Weather Training Facility will be compatible with existing buildings constructed on Keesler AFB since 1972.

4.4 SHORT-TERM IMPACTS OF THE PROJECT

An assessment of the short-term impacts of the proposed action on the physical, biological, and socioeconomic sectors of the region is provided in the following sections.

4.4.1 PHYSICAL SYSTEMS

Short-term impacts to physical systems are expected to primarily result from construction activities.

- Limited soil erosion will occur during construction of the Weather Training Facility due to removal of the impervious parking surface and excavation of the building foundation.

- Surface water quality may decrease temporarily due to increased runoff from construction activities.

- There will be a temporary local elevation in noise levels near the construction and renovation area due to the operation of construction machinery and power tools.

- Operation of heavy machinery during demolition of existing buildings at the proposed site of the Weather Training Facility and during construction of the new facility will temporarily decrease air quality, as a result of gaseous emissions and airborne dust particles.

- Shallow groundwater aquifers may be affected by construction, but confined aquifers are not expected to be influenced by the project.

4.4.2 BIOLOGICAL SYSTEMS

Short-term impacts to biological systems in the Biloxi/Keesler AFB region are also expected to primarily result from construction activities.

During construction of the Weather Training Facility and NEXRAD radar installation, some change in the quality of stormwater runoff would be expected, although measures would be taken to minimize surface runoff from the construction sites. A short-term increase in stormwater turbidity would have a minimal impact upon benthic invertebrate communities in the salt marsh at the northern edge of Keesler AFB. More mobile aquatic organisms would be able to avoid local short-term reductions in water quality. Since very little surface runoff from the Weather Training Facility construction site is expected to reach the Back Bay of Biloxi due to the highly pervious nature of the soils, no significant short-term impact is expected from the proposed project.

Temporary elevations in noise levels and reductions in air quality at the proposed construction sites are not expected to significantly affect wildlife populations. No significant short-term impacts to vegetation and wildlife are expected as a result of the proposed renovation projects.

4.4.3 SOCIOECONOMIC SYSTEMS

Short-term impacts on labor and income will result from construction activities. The construction industry, which has declined in employment during the 1980s, will be impacted positively as a result of the construction activities associated with the relocation of the training missions from Chanute AFB to Keesler AFB. Traffic circulation and parking on-base during the construction phase may present a temporary reduction in convenience for drivers.

4.5 LONG-TERM IMPACTS OF THE PROJECT

In addition to the short-term impacts of a proposed action, the long-term impacts on the region must also be considered. An analyses of these impacts on the Keesler AFB/Biloxi region is provided in the following sections.

4.5.1 PHYSICAL SYSTEMS

Negative long-term impacts to the physical environment are not expected as a result of construction activities or the operation of the proposed facilities.

4.5.2 BIOLOGICAL SYSTEMS

No significant long-term impacts on biological systems are anticipated as a result of the proposed renovation and construction projects. However, an increase in demand is expected on the recreational water facilities and fishing in the Biloxi/Keesler AFB area by the additional personnel assigned to the Weather Training Facility.

4.5.3 SOCIOECONOMIC SYSTEMS

Long-term resource commitments required by the project, primarily fossil fuels for energy and construction materials, will not be recoverable. Permanent employment, income, retail sales, and housing in the region will be impacted positively as a result of the realignment of the training missions from Chanute AFB to Keesler AFB. Potential demands

for public services and demands on public facilities' capacities are likely to be more than offset by the increase in sales and property tax revenues generated by the activity.

4.6 ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL OF PROJECT

Demolition of existing buildings, construction of new facilities, renovation of existing facilities, and operation of completed facilities associated with the proposed action will require energy in the form of various fossil fuels, electricity, and natural gas. Additional amounts of energy will be required by the personnel relocated to Keesler AFB and the surrounding areas. These energy requirements are not currently fully developed. However, the target energy budget figure for the Weather Training Facility is approximately 40,000 BTU/square foot/year. Electric power will be required for lighting, equipment, ventilation and air conditioning in the facility. Natural gas will be used for heating. Adequate supplies of electricity and natural gas are expected to be available in the quantities required and should not have an effect on the local market (USAF 1989a).

During design of the Weather Training Facility, special emphasis will be placed on selection of materials and equipment that will require minimum maintenance effort both in man-hours and expenditure of funds. Emphasis will be placed on designing systems that will provide energy savings. In addition, the new facility will be connected to the Energy Management Control System (EMCS) for the base (USAF 1989a).

4.7 URBAN QUALITY, HISTORIC AND CULTURAL RESOURCES, AND THE DESIGN OF THE BUILT ENVIRONMENT, INCLUDING THE RE-USE AND CONSERVATION POTENTIAL OF THE PROPOSED ACTION

The relocation of the Weather Training Division to Keesler AFB is not expected to degrade the urban quality on-base except for a slight increase in traffic congestion due to the additional personnel stationed at Keesler AFB. In fact, urban quality may actually improve on the base with the removal of several old buildings, construction of a new building (the Weather Training Facility), and renovation of the Dormitory and

Dining Hall. These improvements should improve the overall appearance of the base and improve the quality of the built environment.

Historic and cultural resources of the area are not expected to be impacted by the proposed action. The buildings on the proposed site of the Weather Training Facility are not historically or culturally valuable. Conservation of historic or cultural resources would only be realized during surveys of the construction sites if any resources were determined to exist on the sites.

Short-term soil conservation at the construction sites will be aided by proper construction procedures and techniques. Long-term soil conservation will utilize landscape vegetation to stabilize and hold the so' in the vicinity of the completed facilities.

4.8 PROBABLE ADVERSE ENVIRONMENTAL IMPACTS WHICH CANNOT BE AVOIDED SHOULD PROPOSAL BE IMPLEMENTED

Construction of the Weather Training Facility and the NEXRAD radar installation will result in minor alterations to the topography of the sites. Alterations will be very minor at the Weather Training Facility since this site is essentially flat. Exposure of surface soils during construction will cause some erosion, especially due to stormwater runoff. Fugitive dust levels will temporarily increase and air quality will be reduced due to exhaust emissions in the immediate vicinity of the project sites during construction of the facilities.

Temporary increases in suspended solids loading due to soil erosion could occur during construction and renovation, impacting the quality of surface water in the immediate vicinity.

Construction of the NEXRAD facility will result in the elimination of pine forest and wildlife habitat in an area approximately 10,000 square feet in size.

4.9 MEANS TO MITIGATE ADVERSE ENVIRONMENTAL IMPACTS

Adverse impacts resulting from implementation of the proposed action can be minimized or reduced by the following procedures:

Correct health and safety procedures will be followed during demolition and removal of the buildings containing asbestos at the proposed Weather Training Facility site.

During construction and renovation of the facilities, noise-producing activities will generally be conducted during daylight or normal operating hours.

Soil conservation at the construction sites will be aided by proper construction procedures and techniques including proper soil erosion control. As soon as possible following completion of the facilities, disturbed areas in the vicinity of the facilities will be revegetated with natural or landscape vegetation to stabilize and hold the soil around the completed facilities.

During demolition and construction, equipment refueling, maintenance, and washdown areas will be designated to minimize pollutant loading runoff, and a sound spill containment plan will be implemented.

4.10 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The proposed project and associated demolition, construction, renovation, and operation of the completed facilities will require the commitment of resources including labor, capital, energy, building materials, and biological and land resources. The commitment of land resources should be considered long term since the facilities are considered permanent. The land could be converted to alternative use after operation of the facilities is completed; however, this is not in the foreseeable future.

Construction of the NEXRAD radar installation will result in the clearing of an area approximately 100 by 100 foot square at the site. A security fence will be constructed around the site and will remain in place during the life of the project. The fence will act as a barrier to larger wildlife (excluding birds) and, thus, result in the loss of this wildlife habitat.

The proposed project will also require the commitment of various sources of energy (including electricity, natural gas, and petroleum products) to operate and maintain the facilities. Additional energy will be required by the personnel relocated to Keesler AFB in connection with the proposed action.

5.0 LIST OF PREPARERS

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